THERMAL ARC®

P-Wee®
160S

INVERTER ARC WELDER

Service Manual

May 5, 2005 **Manual No. 0-4755 Version AA**

CE

WARNINGS

Read and understand this entire Manual and your employer's safety practices before installing, operating, or servicing the equipment.

While the information contained in this Manual represents the Manufacturer's best judgement, the Manufacturer assumes no liability for its use.

160S
Inverter Arc Welder
Service Manual Number 0-4755

For the Following Catalog/Part Number:
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SECTION 1:
ARC WELDING SAFETY INSTRUCTIONS AND WARNINGS

WARNING

PROTECT YOURSELF AND OTHERS FROM POSSIBLE SERIOUS INJURY OR DEATH. KEEP CHILDREN AWAY. PACEMAKER WEARERS KEEP AWAY UNTIL CONSULTING YOUR DOCTOR. DO NOT LOSE THESE INSTRUCTIONS. READ OPERATING/ INSTRUCTION MANUAL BEFORE INSTALLING, OPERATING OR SERVICING THIS EQUIPMENT.

Welding products and welding processes can cause serious injury or death, or damage to other equipment or property, if the operator does not strictly observe all safety rules and take precautionary actions.

Safe practices have developed from past experience in the use of welding and cutting. These practices must be learned through study and training before using this equipment. Anyone not having extensive training in welding and cutting practices should not attempt to weld. Certain of the practices apply to equipment connected to power lines; other practices apply to engine driven equipment.

Safe practices are outlined in the American National Standard Z49.1 entitled: SAFETY IN WELDING AND CUTTING. This publication and other guides to what you should learn before operating this equipment are listed at the end of these safety precautions.

HAVE ALL INSTALLATION, OPERATION, MAINTENANCE, AND REPAIR WORK PERFORMED ONLY BY QUALIFIED PEOPLE.

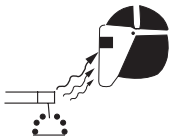
WARNING

ELECTRIC SHOCK can kill.

Touching live electrical parts can cause fatal shocks or severe burns. The electrode and work circuit is electrically live whenever the output is on. The input power circuit and machine internal circuits are also live when power is on. In semiautomatic or automatic wire welding, the wire, wire reel, drive roll housing, and all metal parts touching the welding wire are electrically live. Incorrectly installed or improperly grounded equipment is a hazard.

1. Do not touch live electrical parts.
2. Wear dry, hole-free insulating gloves and body protection.
3. Insulate yourself from work and ground using dry insulating mats or covers.
4. Disconnect input power or stop engine before installing or servicing this equipment. Lock input power disconnect switch open, or remove line fuses so power cannot be turned on accidentally.
5. Properly install and ground this equipment according to its Owner's Manual and national, state, and local codes.
6. Turn off all equipment when not in use. Disconnect power to equipment if it will be left unattended or out of service.
7. Use fully insulated electrode holders. Never dip holder in water to cool it or lay it down on the ground or the work surface. Do not touch holders connected to two welding machines at the same time or touch other people with the holder or electrode.
8. Do not use worn, damaged, undersized, or poorly spliced cables.
9. Do not wrap cables around your body.
10. Ground the workpiece to a good electrical (earth) ground.
11. Do not touch electrode while in contact with the work (ground) circuit.
12. Use only well-maintained equipment. Repair or replace damaged parts at once.

13. In confined spaces or damp locations, do not use a welder with AC output unless it is equipped with a voltage reducer. Use equipment with DC output.
14. Wear a safety harness to prevent falling if working above floor level.
15. Keep all panels and covers securely in place.



WARNING

ARC RAYS can burn eyes and skin; NOISE can damage hearing.

Arc rays from the welding process produce intense heat and strong ultraviolet rays that can burn eyes and skin. Noise from some processes can damage hearing.

1. Wear a welding helmet fitted with a proper shade of filter (see ANSI Z49.1 listed in Safety Standards) to protect your face and eyes when welding or watching.
2. Wear approved safety glasses. Side shields recommended.
3. Use protective screens or barriers to protect others from flash and glare; warn others not to watch the arc.
4. Wear protective clothing made from durable, flame-resistant material (wool and leather) and foot protection.
5. Use approved ear plugs or ear muffs if noise level is high.

WARNING

FUMES AND GASES can be hazardous to your health.

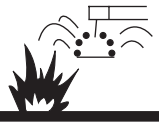
Welding produces fumes and gases. Breathing these fumes and gases can be hazardous to your health.

1. Keep your head out of the fumes. Do not breath the fumes.
2. If inside, ventilate the area and/or use exhaust at the arc to remove welding fumes and gases.
3. If ventilation is poor, use an approved air-supplied respirator.
4. Read the Material Safety Data Sheets (MSDSs) and the manufacturer's instruction for metals, consumables, coatings, and cleaners.

Eye protection filter shade selector for welding or cutting (goggles or helmet), from AWS A6.2-73.

Welding or cutting	*Electrode Size*	*Filter*	*Welding or cutting*	*Electrode Size*	*Filter*
Torch soldering		2	**Gas metal-arc**		
Torch brazing		3 or 4	Non-ferrous base metal	All	11
Oxygen Cutting			Ferrous base metal	All	12
Light	Under 1 in., 25 mm	3 or 4	Gas tungsten arc welding	All	12
Heavy	1 to 6 in., 25-150 mm	4 or 5	(TIG)	All	12
Medium	Over 6 in., 150 mm	5 or 6	Atomic hydrogen welding	All	12
Gas welding			Carbon arc welding	All	12
Light	Under 1/8 in., 3 mm	4 or 5	Plasma arc welding		
Heavy	1/8 to 1/2 in., 3-12 mm	5 or 6	**Carbon arc air gouging**		
Medium	Over 1/2 in., 12 mm	6 or 8	Light		12
Shielded metal-arc	Under 5/32 in., 4 mm	10	Heavy		14
	5/32 to 1/4 in.,	12	**Plasma arc cutting**		
	Over 1/4 in., 6.4 mm	14	Light	Under 300 Amp	9
			Heavy	300 to 400 Amp	12
			Medium	Over 400 Amp	14

5. Work in a confined space only if it is well ventilated, or while wearing an air-supplied respirator. Shielding gases used for welding can displace air causing injury or death. Be sure the breathing air is safe.
6. Do not weld in locations near degreasing, cleaning, or spraying operations. The heat and rays of the arc can react with vapors to form highly toxic and irritating gases.
7. Do not weld on coated metals, such as galvanized, lead, or cadmium plated steel, unless the coating is removed from the weld area, the area is well ventilated, and if necessary, while wearing an air-supplied respirator. The coatings and any metals containing these elements can give off toxic fumes if welded.



WARNING

WELDING can cause fire or explosion.

Sparks and spatter fly off from the welding arc. The flying sparks and hot metal, weld spatter, hot workpiece, and hot equipment can cause fires and burns. Accidental contact of electrode or welding wire to metal objects can cause sparks, overheating, or fire.

1. Protect yourself and others from flying sparks and hot metal.
2. Do not weld where flying sparks can strike flammable material.
3. Remove all flammables within 35 ft (10.7 m) of the welding arc. If this is not possible, tightly cover them with approved covers.
4. Be alert that welding sparks and hot materials from welding can easily go through small cracks and openings to adjacent areas.
5. Watch for fire, and keep a fire extinguisher nearby.
6. Be aware that welding on a ceiling, floor, bulkhead, or partition can cause fire on the hidden side.
7. Do not weld on closed containers such as tanks or drums.
8. Connect work cable to the work as close to the welding area as practical to prevent welding current from traveling long, possibly unknown paths and causing electric shock and fire hazards.
9. Do not use welder to thaw frozen pipes.
10. Remove stick electrode from holder or cut off welding wire at contact tip when not in use.

WARNING

FLYING SPARKS AND HOT METAL can cause injury.

Chipping and grinding cause flying metal. As welds cool, they can throw off slag.

1. Wear approved face shield or safety goggles. Side shields recommended.
2. Wear proper body protection to protect skin.

WARNING

CYLINDERS can explode if damaged.

Shielding gas cylinders contain gas under high pressure. If damaged, a cylinder can explode. Since gas cylinders are normally part of the welding process, be sure to treat them carefully.

1. Protect compressed gas cylinders from excessive heat, mechanical shocks, and arcs.
2. Install and secure cylinders in an upright position by chaining them to a stationary support or equipment cylinder rack to prevent falling or tipping.
3. Keep cylinders away from any welding or other electrical circuits.
4. Never allow a welding electrode to touch any cylinder.

5. Use only correct shielding gas cylinders, regulators, hoses, and fittings designed for the specific application; maintain them and associated parts in good condition.
6. Turn face away from valve outlet when opening cylinder valve.
7. Keep protective cap in place over valve except when cylinder is in use or connected for use.
8. Read and follow instructions on compressed gas cylinders, associated equipment, and CGA publication P-1 listed in Safety Standards.

WARNING

Engines can be dangerous.

WARNING

ENGINE EXHAUST GASES can kill.

Engines produce harmful exhaust gases.

1. Use equipment outside in open, well-ventilated areas.
2. If used in a closed area, vent engine exhaust outside and away from any building air intakes.

WARNING

ENGINE FUEL can cause fire or explosion.

Engine fuel is highly flammable.

1. Stop engine before checking or adding fuel.
2. Do not add fuel while smoking or if unit is near any sparks or open flames.
3. Allow engine to cool before fueling. If possible, check and add fuel to cold engine before beginning job.
4. Do not overfill tank — allow room for fuel to expand.
5. Do not spill fuel. If fuel is spilled, clean up before starting engine.

WARNING

MOVING PARTS can cause injury.

Moving parts, such as fans, rotors, and belts can cut fingers and hands and catch loose clothing.

1. Keep all doors, panels, covers, and guards closed and securely in place.
2. Stop engine before installing or connecting unit.
3. Have only qualified people remove guards or covers for maintenance and troubleshooting as necessary.
4. To prevent accidental starting during servicing, disconnect negative (-) battery cable from battery.
5. Keep hands, hair, loose clothing, and tools away from moving parts.
6. Reinstall panels or guards and close doors when servicing is finished and before starting engine.

WARNING

SPARKS can cause BATTERY GASES TO EXPLODE; BATTERY ACID can burn eyes and skin.

Batteries contain acid and generate explosive gases.

1. Always wear a face shield when working on a battery.
2. Stop engine before disconnecting or connecting battery cables.
3. Do not allow tools to cause sparks when working on a battery.
4. Do not use welder to charge batteries or jump start vehicles.
5. Observe correct polarity (+ and –) on batteries.

WARNING

STEAM AND PRESSURIZED HOT COOLANT can burn face, eyes, and skin.

The coolant in the radiator can be very hot and under pressure.

1. Do not remove radiator cap when engine is hot. Allow engine to cool.
2. Wear gloves and put a rag over cap area when removing cap.
3. Allow pressure to escape before completely removing cap.

WARNING

This product, when used for welding or cutting, produces fumes or gases which contain chemicals know to the State of California to cause birth defects and, in some cases, cancer. (California Health & Safety code Sec. 25249.5 et seq.)

NOTE

Considerations About Welding And The Effects of Low Frequency Electric and Magnetic Fields

The following is a quotation from the General Conclusions Section of the U.S. Congress, Office of Technology Assessment, Biological Effects of Power Frequency Electric & Magnetic Fields - Background Paper, OTA-BP-E-63 (Washington, DC: U.S. Government Printing Office, May 1989): "...there is now a very large volume of scientific findings based on experiments at the cellular level and from studies with animals and people which clearly establish that low frequency magnetic fields and interact with, and produce changes in, biological systems. While most of this work is of very high quality, the results are complex. Current scientific understanding does not yet allow us to interpret the evidence in a single coherent framework. Even more frustrating, it does not yet allow us to draw definite conclusions about questions of possible risk or to offer clear science-based advice on strategies to minimize or avoid potential risks."

To reduce magnetic fields in the workplace, use the following procedures.

1. Keep cables close together by twisting or taping them.
2. Arrange cables to one side and away from the operator.
3. Do not coil or drape cable around the body.
4. Keep welding power source and cables as far away from body as practical.

ABOUT PACEMAKERS:

The above procedures are among those also normally recommended for pacemaker wearers. Consult your doctor for complete information.

1.01 PRINCIPAL SAFETY STANDARDS

Safety in Welding and Cutting, ANSI Standard Z49.1, from American Welding Society, 550 N.W. LeJeune Rd., Miami, FL 33126.

Safety and Health Standards, OSHA 29 CFR 1910, from Superintendent of Documents, U.S. Government Printing Office, Washington, D.C. 20402.

Recommended Safe Practices for the Preparation for Welding and Cutting of Containers That Have Held Hazardous Substances, American Welding Society Standard AWS F4.1, from American Welding Society, 550 N.W. LeJeune Rd., Miami, FL 33126.

National Electrical Code, NFPA Standard 70, from National Fire Protection Association, Batterymarch Park, Quincy, MA 02269.

Safe Handling of Compressed Gases in Cylinders, CGA Pamphlet P-1, from Compressed Gas Association, 1235 Jefferson Davis Highway, Suite 501, Arlington, VA 22202.

Code for Safety in Welding and Cutting, CSA Standard W117.2, from Canadian Standards Association, Standards Sales, 178 Rexdale Boulevard, Rexdale, Ontario, Canada M9W 1R3.

Safe Practices for Occupation and Educational Eye and Face Protection, ANSI Standard Z87.1, from American National Standards Institute, 1430 Broadway, New York, NY 10018.

Cutting and Welding Processes, NFPA Standard 51B, from National Fire Protection Association, Batterymarch Park, Quincy, MA 02269.

PRECAUTIONS DE SECURITE EN SOUDAGE A L'ARC

MISE EN GARDE

LE SOUDAGE A L'ARC EST DANGEREUX

PROTEGEZ-VOUS, AINSI QUE LES AUTRES, CONTRE LES BLESSURES GRAVES POSSIBLES OU LA MORT. NE LAISSEZ PAS LES ENFANTS S'APPROCHER, NI LES PORTEURS DE STIMULATEUR CARDIAQUE (A MOINS QU'ILS N'AIENT CONSULTE UN MEDECIN). CONSERVEZ CES INSTRUCTIONS. LISEZ LE MANUEL D'OPERATION OU LES INSTRUCTIONS AVANT D'INSTALLER, UTILISER OU ENTRETENIR CET EQUIPEMENT.

Les produits et procédés de soudage peuvent sauser des blessures graves ou la mort, de même que des dommages au reste du matériel et à la propriété, si l'utilisateur n'adhère pas strictement à toutes les règles de sécurité et ne prend pas les précautions nécessaires.

En soudage et coupage, des pratiques sécuritaires se sont développées suite à l'expérience passée. Ces pratiques doivent être apprises par étude ou entraînement avant d'utiliser l'equipement. Toute personne n'ayant pas suivi un entraînement intensif en soudage et coupage ne devrait pas tenter de souder. Certaines pratiques concernent les équipements raccordés aux lignes d'alimentation alors que d'autres s'adressent aux groupes électrogènes.

La norme Z49.1 de l'American National Standard, intitulée "SAFETY IN WELDING AND CUTTING" présente les pratiques sécuritaires à suivre. Ce document ainsi que d'autres guides que vous devriez connaître avant d'utiliser cet équipement sont présentés à la fin de ces instructions de sécurité.

SEULES DES PERSONNES QUALIFIEES DOIVENT FAIRE DES TRAVAUX D'INSTALLATION, DE REPARATION, D'ENTRETIEN ET D'ESSAI.

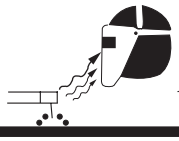
AVERTISSEMENT

L'ELECTROCUTION PEUT ETRE MORTELLE.

Une décharge électrique peut tuer ou brûler gravement. L'électrode et le circuit de soudage sont sous tension dès la mise en circuit. Le circuit d'alimentation et les circuits internes de l'équipement sont aussi sous tension dès la mise en marche. En soudage automatique ou semi-automatique avec fil, ce dernier, le rouleau ou la bobine de fil, le logement des galets d'entrainement et toutes les pièces métalliques en contact avec le fil de soudage sont sous tension. Un équipement inadéquatement installé ou inadéquatement mis à la terre est dangereux.

1. Ne touchez pas à des pièces sous tension.
2. Portez des gants et des vêtements isolants, secs et non troués.
3 Isolez-vous de la pièce à souder et de la mise à la terre au moyen de tapis isolants ou autres.
4. Déconnectez la prise d'alimentation de l'équipement ou arrêtez le moteur avant de l'installer ou d'en faire l'entretien. Bloquez le commutateur en circuit ouvert ou enlevez les fusibles de l'alimentation afin d'éviter une mise en marche accidentelle.
5. Veuillez à installer cet équipement et à le mettre à la terre selon le manuel d'utilisation et les codes nationaux, provinciaux et locaux applicables.
6. Arrêtez tout équipement après usage. Coupez l'alimentation de l'équipement s'il est hors d'usage ou inutilisé.
7. N'utilisez que des porte-électrodes bien isolés. Ne jamais plonger les porte-électrodes dans l'eau pour les refroidir. Ne jamais les laisser traîner par terre ou sur les pièces à souder. Ne touchez pas aux porte-électrodes raccordés à deux sources de courant en même temps. Ne jamais toucher quelqu'un d'autre avec l'électrode ou le porte-électrode.

8. N'utilisez pas de câbles électriques usés, endommagés, mal épissés ou de section trop petite.
9. N'enroulez pas de câbles électriques autour de votre corps.
10. N'utilisez qu'une bonne prise de masse pour la mise à la terre de la pièce à souder.
11. Ne touchez pas à l'électrode lorsqu'en contact avec le circuit de soudage (terre).
12. N'utilisez que des équipements en bon état. Réparez ou remplacez aussitôt les pièces endommagées.
13. Dans des espaces confinés ou mouillés, n'utilisez pas de source de courant alternatif, à moins qu'il soit muni d'un réducteur de tension. Utilisez plutôt une source de courant continu.
14. Portez un harnais de sécurité si vous travaillez en hauteur.
15. Fermez solidement tous les panneaux et les capots.



AVERTISSEMENT

LE RAYONNEMENT DE L'ARC PEUT BRÛLER LES YEUX ET LA PEAU; LE BRUIT PEUT ENDOMMAGER L'OUIE.

L'arc de soudage produit une chaleur et des rayons ultraviolets intenses, susceptibles de brûler les yeux et la peau. Le bruit causé par certains procédés peut endommager l'ouïe.

1. Portez une casque de soudeur avec filtre oculaire de nuance appropriée (consultez la norme ANSI Z49 indiquée ci-après) pour vous protéger le visage et les yeux lorsque vous soudez ou que vous observez l'exécution d'une soudure.
2. Portez des lunettes de sécurité approuvées. Des écrans latéraux sont recommandés.
3. Entourez l'aire de soudage de rideaux ou de cloisons pour protéger les autres des coups d'arc ou de l'éblouissement; avertissez les observateurs de ne pas regarder l'arc.
4. Portez des vêtements en matériaux ignifuges et durables (laine et cuir) et des chaussures de sécurité.

SELECTION DES NUANCES DE FILTRES OCULAIRS POUR LA PROTECTION DES YEUX EN COUPAGE ET SOUDAGE (selon AWS á 8.2-73)

Opération de coupage ou soudage	Dimension d'électrode ou Epiasseur de métal ou Intensité de courant	Nuance de filtre oculaire	Opération de coupage ou soudage	Dimension d'électrode ou Epiasseur de métal ou Intensité de courant	Nuance de filtre oculaire
Brassage tendre au chalumeau	toutes conditions	2	Soudage á l'arc sous gaz avec fil plein (GMAW)		
Brassage fort au chalumeau	toutes conditions	3 ou 4	métaux non-ferreux	toutes conditions	11
Oxycoupage			métaux ferreux	toutes conditions	12
mince	moins de 1 po. (25 mm)	2 ou 3	Soudage á l'arc sous gaz avec électrode de tungstène (GTAW)	toutes conditions	12
moyen	de 1 á 6 po. (25 á 150 mm)	4 ou 5	Soudage á l'hydrogène atomique (AHW)	toutes conditions	12
épais	plus de 6 po. (150 mm)	5 ou 6	Soudage á l'arc avec électrode de carbone (CAW)	toutes conditions	12
Soudage aux gaz			Soudage á l'arc Plasma (PAW)	toutes dimensions	12
mince	moins de 1/8 po. (3 mm)	4 ou 5	Gougeage Air-Arc avec électrode de carbone		
moyen	de 1/8 á 1/2 po. (3 á 12 mm)	5 ou 6	mince		12
épais	plus de 1/2 po. (12 mm)	6 ou 8	épais		14
Soudage á l'arc avec électrode enrobees (SMAW)	moins de 5/32 po. (4 mm)	10	Coupage á l'arc Plasma (PAC)		
	5/32 á 1/4 po. (4 á 6.4 mm)	12	mince	moins de 300 amperès	9
	plus de 1/4 po. (6.4 mm)	14	moyen	de 300 á 400 amperès	12
			épais	plus de 400 amperès	14

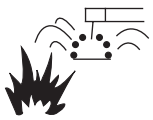
5. Portez un casque antibruit ou des bouchons d'oreille approuvés lorsque le niveau de bruit est élevé.

AVERTISSEMENT

LES VAPEURS ET LES FUMEES SONT DANGEREUSES POUR LA SANTE.

Le soudage dégage des vapeurs et des fumées dangereuses à respirer.

1. Eloignez la tête des fumées pour éviter de les respirer.
2. A l'intérieur, assurez-vous que l'aire de soudage est bien ventilée ou que les fumées et les vapeurs sont aspirées à l'arc.
3. Si la ventilation est inadequate, portez un respirateur à adduction d'air approuvé.
4. Lisez les fiches signalétiques et les consignes du fabricant relatives aux métaux, aux produits consummables, aux revêtements et aux produits nettoyants.
5. Ne travaillez dans un espace confiné que s'il est bien ventilé; sinon, portez un respirateur à adduction d'air. Les gaz protecteurs de soudage peuvent déplacer l'oxygène de l'air et ainsi causer des malaises ou la mort. Assurez-vous que l'air est propre à la respiration.
6. Ne soudez pas à proximité d'opérations de dégraissage, de nettoyage ou de pulvérisation. La chaleur et les rayons de l'arc peuvent réagir avec des vapeurs et former des gaz hautement toxiques et irritants.
7. Ne soudez des tôles galvanisées ou plaquées au plomb ou au cadmium que si les zones à souder ont été grattées à fond, que si l'espace est bien ventilé; si nécessaire portez un respirateur à adduction d'air. Car ces revêtements et tout métal qui contient ces éléments peuvent dégager des fumées toxiques au moment du soudage.

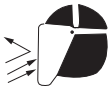


AVERTISSEMENT

LE SOUDAGE PEUT CAUSER UN INCENDIE OU UNE EXPLOSION

L'arc produit des étincellies et des projections. Les particules volantes, le métal chaud, les projections de soudure et l'équipement surchauffé peuvent causer un incendie et des brûlures. Le contact accidentel de l'électrode ou du fil-électrode avec un objet métallique peut provoquer des étincelles, un échauffement ou un incendie.

1. Protégez-vous, ainsi que les autres, contre les étincelles et du métal chaud.
2. Ne soudez pas dans un endroit où des particules volantes ou des projections peuvent atteindre des matériaux inflammables.
3. Enlevez toutes matières inflammables dans un rayon de 10, 7 mètres autour de l'arc, ou couvrez-les soigneusement avec des bâches approuvées.
4. Méfiez-vous des projections brulantes de soudage susceptibles de pénétrer dans des aires adjacentes par de petites ouvertures ou fissures.
5. Méfiez-vous des incendies et gardez un extincteur à portée de la main.
6. N'oubliez pas qu'une soudure réalisée sur un plafond, un plancher, une cloison ou une paroi peut enflammer l'autre côté.
7. Ne soudez pas un récipient fermé, tel un réservoir ou un baril.
8. Connectez le câble de soudage le plus près possible de la zone de soudage pour empêcher le courant de suivre un long parcours inconnu, et prévenir ainsi les risques d'électrocution et d'incendie.
9. Ne dégelez pas les tuyaux avec un source de courant.
10. Otez l'électrode du porte-électrode ou coupez le fil au tube-contact lorsqu'inutilisé après le soudage.
11. Portez des vêtements protecteurs non huileux, tels des gants en cuir, une chemise épaisse, un pantalon revers, des bottines de sécurité et un casque.



AVERTISSEMENT

LES ETINCELLES ET LES PROJECTIONS BRULANTES PEUVENT CAUSER DES BLESSURES.

Le piquage et le meulage produisent des particules métalliques volantes. En refroidissant, la soudure peut projeter du éclats de laitier.

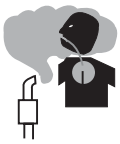
1. Portez un écran facial ou des lunettes protectrices approuvées. Des écrans latéraux sont recommandés.
2. Portez des vêtements appropriés pour protéger la peau.

AVERTISSEMENT

LES BOUTEILLES ENDOMMAGEES PEUVENT EXPLOSER

Les bouteilles contiennent des gaz protecteurs sous haute pression. Des bouteilles endommagées peuvent exploser. Comme les bouteilles font normalement partie du procédé de soudage, traitez-les avec soin.

1. Protégez les bouteilles de gaz comprimé contre les sources de chaleur intense, les chocs et les arcs de soudage.
2. Enchainez verticalement les bouteilles à un support ou à un cadre fixe pour les empêcher de tomber ou d'être renversées.
3. Eloignez les bouteilles de tout circuit électrique ou de tout soudage.
4. Empêchez tout contact entre une bouteille et une électrode de soudage.
5. N'utilisez que des bouteilles de gaz protecteur, des détendeurs, des boyauxs et des raccords conçus pour chaque application spécifique; ces équipements et les pièces connexes doivent être maintenus en bon état.
6. Ne placez pas le visage face à l'ouverture du robinet de la bouteille lors de son ouverture.
7. Laissez en place le chapeau de bouteille sauf si en utilisation ou lorsque raccordé pour utilisation.
8. Lisez et respectez les consignes relatives aux bouteilles de gaz comprimé et aux équipements connexes, ainsi que la publication P-1 de la CGA, identifiée dans la liste de documents ci-dessous.



AVERTISSEMENT

LES MOTEURS PEUVENT ETRE DANGEREUX

LES GAZ D'ECHAPPEMENT DES MOTEURS PEUVENT ETRE MORTELS.

Les moteurs produisent des gaz d'échappement nocifs.

1. Utilisez l'équipement à l'extérieur dans des aires ouvertes et bien ventilées.
2. Si vous utilisez ces équipements dans un endroit confiné, les fumées d'échappement doivent être envoyées à l'extérieur, loin des prises d'air du bâtiment.

AVERTISSEMENT

LE CARBURANT PEUR CAUSER UN INCENDIE OU UNE EXPLOSION.

Le carburant est hautement inflammable.

1. Arrêtez le moteur avant de vérifier le niveau e carburant ou de faire le plein.
2. Ne faites pas le plein en fumant ou proche d'une source d'étincelles ou d'une flamme nue.
3. Si c'est possible, laissez le moteur refroidir avant de faire le plein de carburant ou d'en vérifier le niveau au début du soudage.
4. Ne faites pas le plein de carburant à ras bord: prévoyez de l'espace pour son expansion.
5. Faites attention de ne pas renverser de carburant. Nettoyez tout carburant renversé avant de faire démarrer le moteur.

AVERTISSEMENT

DES PIECES EN MOUVEMENT PEUVENT CAUSER DES BLESSURES.

Des pièces en mouvement, tels des ventilateurs, des rotors et des courroies peuvent couper doigts et mains, ou accrocher des vêtements amples.

1. Assurez-vous que les portes, les panneaux, les capots et les protecteurs soient bien fermés.
2. Avant d'installer ou de connecter un système, arrêtez le moteur.
3. Seules des personnes qualifiées doivent démonter des protecteurs ou des capots pour faire l'entretien ou le dépannage nécessaire.
4. Pour empêcher un démarrage accidentel pendant l'entretien, débranchez le câble d'accumulateur à la borne négative.
5. N'approchez pas les mains ou les cheveux de pièces en mouvement; elles peuvent aussi accrocher des vêtements amples et des outils.
6. Réinstallez les capots ou les protecteurs et fermez les portes après des travaux d'entretien et avant de faire démarrer le moteur.

AVERTISSEMENT

DES ETINCELLES PEUVENT FAIRE EXPLOSER UN ACCUMULATEUR; L'ELECTROLYTE D'UN ACCUMULATEUR PEUT BRULER LA PEAU ET LES YEUX.

Les accumulateurs contiennent de l'électrolyte acide et dégagent des vapeurs explosives.

1. Portez toujours un écran facial en travaillant sur un accumu-lateur.
2. Arrêtez le moteur avant de connecter ou de déconnecter des câbles d'accumulateur.
3. N'utilisez que des outils anti-étincelles pour travailler sur un accumulateur.
4. N'utilisez pas une source de courant de soudage pour charger un accumulateur ou survolter momentanément un véhicule.
5. Utilisez la polarité correcte (+ et –) de l'accumulateur.

AVERTISSEMENT

LA VAPEUR ET LE LIQUIDE DE REFROIDISSEMENT BRULANT SOUS PRESSION PEUVENT BRULER LA PEAU ET LES YEUX.

Le liquide de refroidissement d'un radiateur peut être brûlant et sous pression.

1. N'ôtez pas le bouchon de radiateur tant que le moteur n'est pas refroidi.
2. Mettez des gants et posez un torchon sur le bouchon pour l'ôter.
3. Laissez la pression s'échapper avant d'ôter complètement le bouchon.

PRINCIPALES NORMES DE SECURITE

Safety in Welding and Cutting, norme ANSI Z49.1, American Welding Society, 550 N.W. LeJeune Rd., Miami, FL 33128.

Safety and Health Standards, OSHA 29 CFR 1910, Superintendent of Documents, U.S. Government Printing Office, Washington, D.C. 20402.

Recommended Safe Practices for the Preparation for Welding and Cutting of Containers That Have Held Hazardous Substances, norme AWS F4.1, American Welding Society, 550 N.W. LeJeune Rd., Miami, FL 33128.

National Electrical Code, norme 70 NFPA, National Fire Protection Association, Batterymarch Park, Quincy, MA 02269.

Safe Handling of Compressed Gases in Cylinders, document P-1, Compressed Gas Association, 1235 Jefferson Davis Highway, Suite 501, Arlington, VA 22202.

Code for Safety in Welding and Cutting, norme CSA W117.2 Association canadienne de normalisation, Standards Sales, 276 Rexdale Boulevard, Rexdale, Ontario, Canada M9W 1R3.

Safe Practices for Occupation and Educational Eye and Face Protection, norme ANSI Z87.1, American National Standards Institute, 1430 Broadway, New York, NY 10018.

Cutting and Welding Processes, norme 51B NFPA, National Fire Protection Association, Batterymarch Park, Quincy, MA 02269.

1.02 DECLARATION OF CONFORMITY

Manufacturer: Thermadyne Corporation
Address: 82 Benning Street
West Lebanon, New Hampshire 03784

USA

The equipment described in this manual conforms to all applicable aspects and regulations of the 'Low Voltage Directive' (European Council Directive 73/23/EEC as amended by Council Directive 93/68/EEC) and to the National legislation for the enforcement of this Directive.

The equipment described in this manual conforms to all applicable aspects and regulations of the "EMC Directive" (European Council Directive 89/336/EEC) and to the National legislation for the enforcement of this Directive.

Serial numbers are unique with each individual piece of equipment and details description, parts used to manufacture a unit and date of manufacture.

National Standard and Technical Specifications

The product is designed and manufactured to a number of standards and technical requirements. Among them are:

- CSA (Canadian Standards Association) standard C22.2 number 60 for Arc welding equipment.
- UL (Underwriters Laboratory) rating 94VO flammability testing for all printed-circuit boards used.
- CENELEC EN50199 EMC Product Standard for Arc Welding Equipment.
- ISO/IEC 60974-1 (BS 638-PT10) (EN 60 974-1) (EN50192) (EN50078) applicable to plasma cutting equipment and associated accessories.
- For environments with increased hazard of electrical shock, Power Supplies bearing the S mark conform to EN50192 when used in conjunction with hand torches with exposed cutting tips, if equipped with properly installed standoff guides.
- Extensive product design verification is conducted at the manufacturing facility as part of the routine design and manufacturing process. This is to ensure the product is safe, when used according to instructions in this manual and related industry standards, and performs as specified. Rigorous testing is incorporated into the manufacturing process to ensure the manufactured product meets or exceeds all design specifications.

Thermadyne has been manufacturing products for more than 30 years, and will continue to achieve excellence in our area of manufacture.

Manufacturers responsible representative:

Steve Ward
Operations Director
Thermadyne Europe
Europa Building
Chorley N Industrial Park
Chorley, Lancashire,
England PR6 7BX

CE

1.03 LIMITED WARRANTY

LIMITED WARRANTY: Thermal Arc®, Inc., A Thermadyne Company, hereafter, "Thermal Arc" warrants to customers of itsauthorized distributors hereafter "Purchaser" that its products will be free of defects in workmanship or material. Should anyfailure to conform to this warranty appear within the time period applicable to the Thermal Arc products as stated below, Thermal Arc shall, upon notification thereof and substantiation that the product has been stored, installed, operated, and maintained in accordance with Thermal Arc's specifications, instructions, recommendations and recognized standard industry practice, and not subject to misuse, repair, neglect, alteration, or accident, correct such defects by suitable repair or replacement, at Thermal Arc's sole option, of any components or parts of the product determined by Thermal Arc to be defective.

THERMAL ARC MAKES NO OTHER WARRANTY, EXPRESS OR IMPLIED. THIS WARRANTY IS EXCLUSIVE AND IN LIEU OF ALL OTHERS, INCLUDING, BUT NOT LIMITED TO ANY WARRANTY OF MERCHANTABILITY OR FITNESS FOR ANY PARTICULAR PURPOSE.

LIMITATION OF LIABILITY: THERMAL ARC SHALL NOT UNDER ANY CIRCUMSTANCES BE LIABLE FOR SPECIAL, INDIRECT OR CONSEQUENTIAL DAMAGES, SUCH AS, BUT NOT LIMITED TO, LOST PROFITS AND BUSINESS INTERRUPTION. The remedies of the Purchaser set forth herein are exclusive and the liability of Thermal Arc with respect to any contract, or anything done in connection therewith such as the performance or breach thereof, or from the manufacture, sale, delivery, resale, or use of any goods covered by or furnished by Thermal Arc whether arising out of contract, negligence, strict tort, or under any warranty, or otherwise, shall not, except as expressly provided herein, exceed the price of the goods upon which such liability is based. No employee, agent, or representative of Thermal Arc is authorized to change this warranty in any way or grant any other warranty.

PURCHASER'S RIGHTS UNDER THIS WARRANTY ARE VOID IF REPLACEMENT PARTS OR ACCESSORIES ARE USED WHICH IN THERMAL ARC'S SOLE JUDGEMENT MAY IMPAIR THE SAFETY OR PERFORMANCE OF ANY THERMAL ARC PRODUCT. PURCHASER'S RIGHTS UNDER THIS WARRANTY ARE VOID IF THE PRODUCT IS SOLD TO PURCHASER BY NON-AUTHORIZED PERSONS.

The warranty is effective for the time stated below beginning on the date that the authorized distributor delivers the products to the Purchaser. Notwithstanding the foregoing, in no event shall the warranty period extend more than the time stated plus one year from the date Thermal Arc delivered the product to the authorized distributor.

POWER SUPPLIES	ALL OTHER POWER SUPPLIES	LABOR
MAIN POWER MAGNETICS (STATIC & ROTATING)	3 YEARS	3 YEAR
ORIGINAL MAIN POWER RECTIFIER	3 YEARS	3 YEAR
CONTROL PC BOARD	3 YEARS	3 YEAR
ALL OTHER CIRCUITS AND COMPONENTS INCLUDING BUT NOT LIMITED TO: CONTACTORS, RELAYS, SOLENOIDS, PUMPS, POWER SWITCHING SEMI-CONDUCTORS.	1 YEAR	1 YEAR
ENGINES: ENGINES ARE NOT WARRANTED BY THERMAL ARC, ALTHOUGH MOST ARE WARRANTED BY THE ENGINE MANUFACTURER. SEE THE ENGINE MANUFACTURE'S WARRANTY FOR DETAILS.	1 YEAR	1 YEAR
CONSOLES, CONTROL EQUIPMENT, HEAT EXCHANGES		
ACCESSORY EQUIPMENT		

NOTE: Dragster 85® excluded from this policy. Refer to Dragster 85 warranty in Dragster 85 Owner's Manual.

Warranty repairs or replacement claims under this limited warranty must be submitted to Thermal Arc by an authorized Thermal Arc repair facility within thirty (30) days of purchaser's notice of any Warranty Claim. No transportation costs of any kind will be paid under this warranty. Transportation charges to send products to an authorized warranty repair facility shall be the responsibility of the Purchaser. All returned goods shall be at the Purchaser's risk and expense. This warranty supersedes all previous Thermal Arc warranties. Thermal Arc® is a Registered Trademark of Thermadyne Industries Inc.

September 27, 2004

SECTION 2: INTRODUCTION

2.01 Scope of Manual

This manual provides service instructions for the Thermal Arc® 160S Inverter Arc Welder. Information in this edition is particularly applicable to the troubleshooting and repair of the equipment. For information on operating procedures, please refer to the 160S Inverter Arc Welder Operating Manual (430429-504).

NOTE

Service of this equipment is restricted to properly trained service technicians familiar with this equipment; unqualified personnel are strictly cautioned against attempting repairs or adjustments not covered in this manual, at the risk of voiding the warranty.

Read both this manual and the Operating Manual thoroughly. A complete understanding of the capabilities and functions of the equipment will assure obtaining the performance for which it was designed.

WARNING

There are extremely dangerous voltage and power levels present inside this unit. Do not attempt to diagnose or repair unless you have had training in high power electronics measurement and troubleshooting.

2.02 General Service Philosophy

Several key points are essential to properly support the application and operation of this equipment.

A. Application

Confirm that the equipment is capable of handling the application desired. Specifications supplied and described in Subsection 2.05 of this manual.

B. Modifications

No physical or electrical modifications other than selection of standard options and accessories are to be made to this equipment.

C. Customer/Operator Responsibilities

It is the customer/operator's responsibility to maintain the equipment and peripheral accessories provided by Thermal Dynamics in good operating order in accordance with the procedures outlined in the Operating Manual, and to protect the equipment from accidental or malicious damage.

D. Repair Restrictions

The electronics consists of printed circuit board assemblies which must be carefully handled, and must be replaced as units. No replacement of printed circuit solder-mounted components is allowed except as noted in this manual.

If the Printed Circuit Board is to be returned, the replaced Printed Circuit Board Assemblies must be properly packaged in protective material and returned intact per normal procedures.

2.03 Service Responsibilities

The Service Technician should be familiar with the equipment and its capabilities and should be prepared to recommend arrangements of components which will provide the most efficient layout, utilizing the equipment to its best possible advantage.

Maintenance work should be accomplished in a timely manner. If problems are encountered, or the equipment does not function as specified, contact:

Thermadyne, Inc.
Thermal Arc Technical Service Department
82 Benning Street
West Lebanon, New Hampshire, USA 03784

(603) 298-5711

http://www.thermadyne.com/tai

2.04 160S Inverter Arc Welder Description

The Thermal Arc™ Model P-Wee 160S is a self contained single-phase DC arc welding power source with Constant Current (CC) output characteristics. This unit is equipped with a Digital Volt/Amperage Meter and lift arc starter, for use with Gas Tungsten Arc Welding (GTAW) and Shielded Metal Arc Welding (SMAW) processes. The power source is totally enclosed in an impact resistant, flame resistant and non-conductive plastic case.

2.05 Symbol Chart

Not all of these symbols will appear on this unit

	On
	Off
	Dangerous Voltage
	Increase/Decrease
	Circuit Breaker
	AC Auxiliary Power
	Fuse
A	Amperage
V	Voltage
Hz	Hertz (cycles/sec)
f	Frequency
	Negative
	Positive
	Direct Current (DC)
	Protective Earth (Ground)
	Line
	Line Connection
	Auxiliary Power
115V 15A	Receptacle Rating- Auxiliary Power

1 ~	Single Phase
3 ~	Three Phase
	Three Phase Static Frequency Converter-Transformer-Rectifier
	Remote
X	Duty Cycle
%	Percentage
	Panel/Local
	Shielded Metal Arc Welding (SMAW)
	Gas Metal Arc Welding (GMAW)
	Gas Tungsten Arc Welding (GTAW)
	Air Carbon Arc Cutting (CAC-A)
	Constant Current
	Constant Voltage Or Constant Potential
	High Temperature
	Fault Indication
	Arc Force
	Touch Start (GTAW)
	Variable Inductance
V	Voltage Input

	Wire Feed Function
	Wire Feed Towards Workpiece With Output Voltage Off.
	Welding Gun
	Purging Of Gas
	Continuous Weld Mode
	Spot Weld Mode
t	Spot Time
t1	Preflow Time
t2	Postflow Time
	2 Step Trigger Operation Press to initiate wirefeed and welding, release to stop.
	4 Step Trigger Operation Press and hold for preflow, release to start arc. Press to stop arc, and hold for preflow.
t	Burnback Time
	Disturbance In Ground System
IPM	Inches Per Minute
MPM	Meters Per Minute

Art # A-04130

2.06 Functional Block Diagrams

Figure 2 illustrates the functional block diagram of the 160S-power supply.

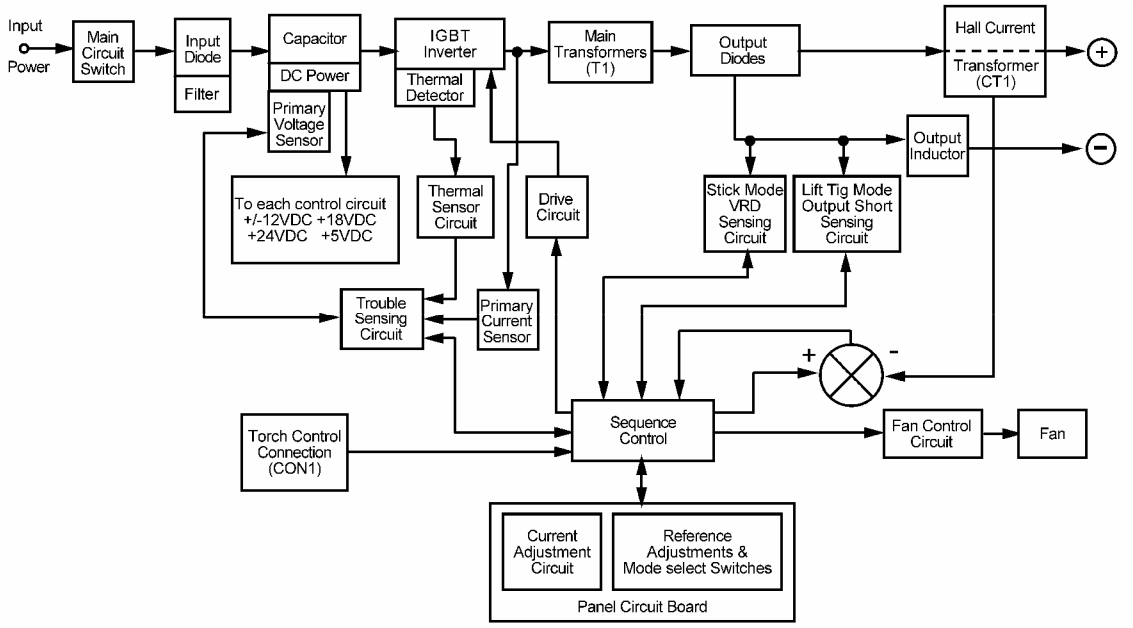


Figure 1. Model 160S Functional Block Diagram

2.07 Transporting Methods

These units are equipped with a handle for carrying purposes.

WARNING 1

ELECTRIC SHOCK can kill. DO NOT TOUCH live electrical parts. Disconnect input power conductors from de-energized supply line before moving the welding power source.

WARNING 2

FALLING EQUIPMENT can cause serious personal injury and equipment damage.

Lift unit with handle on top of case.
Use handcart or similar device of adequate capacity.
If using a fork lift vehicle, place and secure unit on a proper skid before transporting.

3.0 INSTALLATION RECOMMENDATIONS

3.01 Environment

The P-Wee 160S is designed for use in adverse environments.

Examples of environments with increased adverse conditions are -

a. In locations in which freedom of movement is restricted, so that the operator is forced to perform the work in a cramped (kneeling, sitting or lying) position with physical contact with conductive parts;
b. In locations which are fully or partially limited by conductive elements, and in which there is a high risk of unavoidable or accidental contact by the operator, or
c. In wet or damp hot locations where humidity or perspiration considerably reduces the skin resistance of the human body and the insulation properties of accessories.

Environments with adverse conditions do not include places where electrically conductive parts are in the near vicinity of the operator, which can cause increased hazard, have been insulated.

3.02 Location

Be sure to locate the welder according to the following guidelines:

- *In areas, free from moisture and dust.*
- *Ambient temperature between 0 degrees C to 40 degrees C.*
- *In areas, free from oil, steam and corrosive gases.*
- *In areas, not subjected to abnormal vibration or shock.*
- *In areas, not exposed to direct sunlight or rain.*
- *Place at a distance of 12" (304.79mm) or more from walls or similar that could restrict natural airflow for cooling.*

WARNING 3

Thermal Arc advises that this equipment be electrically connected by a qualified electrician.

3.03 Electrical Input Connections

WARNING 4

ELECTRIC SHOCK can kill; SIGNIFICANT DC VOLTAGE is present after removal of input power.

DO NOT TOUCH live electrical parts.
SHUT DOWN welding power source, disconnect input power employing lockout/tagging procedures. Lockout/tagging procedures consist of padlocking line disconnect switch in open position, removing fuses from fuse box, or shutting off and red-tagging circuit breaker or other disconnecting device.

3.03.01 Electrical Input Requirements

Operate the welding power source from a single-phase 50/60 Hz, AC power supply. The input voltage must match one of the electrical input voltages shown on the input data label on the unit nameplate. Contact the local electric utility for information about the type of electrical service available, how proper connections should be made, and inspection required.

The line disconnect switch provides a safe and convenient means to completely remove all electrical power from the welding power supply whenever necessary to inspect or service the unit.

Note 1

These units are equipped with a two-conductor with earth power cable that is connected at the welding power source end for single phase electrical input power.

Do not connect an input (WHITE or BLACK) conductor to the ground terminal.

Do not connect the ground (GREEN) conductor to an input line terminal.

Refer to figure 3 and:

1. Connect end of ground (GREEN) conductor to a suitable ground. Use a grounding method that complies with all applicable electrical codes.
2. Connect ends of line 1 (BLACK) and line 2 (WHITE) input conductors to a de-energized line disconnect switch.
3. Use Table 1 and Table 2 as a guide to select line fuses for the disconnect switch.

Input Voltage	Fuse Size
115 VAC	40 Amps
208-230 VAC	45 Amps

Table 1 Electrical Input Connections

Note 2

Fuse size is based on not more than 200 percent of the rated input amperage of the welding power source (Based on Article 630, National Electrical Code).

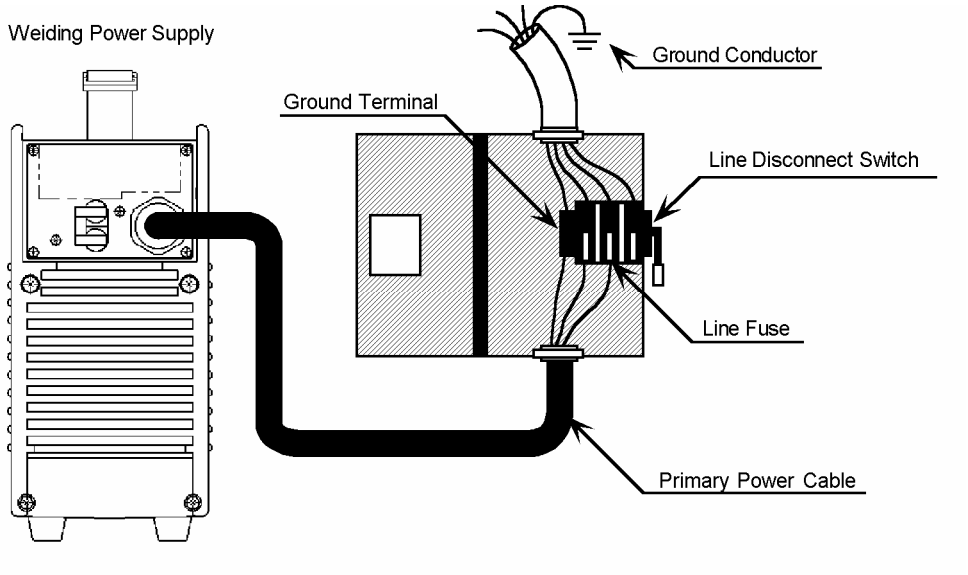


Figure 2. Electrical Input Connections

3.03.02 Input Power

Each unit incorporates an INRUSH circuit and input voltage sensing circuit. When the MAIN CIRCUIT SWITCH is turned on, the inrush circuit provides a pre-charging of the input capacitors. SCR's in the Power Control Assembly (PCA) will turn on after the input capacitors have charged to full operating voltage (after approximately 5 seconds).

Note 3

Note the available input power. Damage to the PCA could occur if 460VAC or higher is applied.

The following 115/230V Primary Current recommendations are required to obtain the maximum welding current and duty cycle from this welding equipment:

Model	Primary Supply Lead Size (Factory Fitted)	Minimum Primary Current Circuit Size (Vin/Amps)	Current & Duty Cycle	
			TIG	STICK
P-Wee 160S	12/3 AWG minimum	115/22	85A @ 100%	-
		208/25	160A @ 35%	-
		230/23		-
		115/38	-	85A @ 100%
		208/42	-	160A @ 35%
		230/38	-	

Table 2 – 115/230V Primary Current Circuit sizes to achieve maximum current

3.03.03 High Frequency Introduction

The importance of correct installation of high frequency welding equipment cannot be over-emphasized. Interference due to high frequency initiated or stabilized arc is almost invariably traced to improper installation. The following information is intended as a guide for personnel installing high frequency welding machines.

Warning

Explosives

The high frequency section of this machine has an output similar to a radio transmitter. The machine should NOT be used in the vicinity of blasting operations due to the danger of premature firing.

Computers

It is also possible that operation close to computer installations may cause computer malfunction.

3.03.04 High Frequency Interference

Interference may be transmitted by a high frequency initiated or stabilized arc welding machine in the following ways:

Direct Radiation

Radiation from the machine can occur if the case is metal and is not properly grounded. It can occur through apertures such as open access panels. The shielding of the high frequency unit in the Power Source will prevent direct radiation if the equipment is properly grounded.

Transmission via the Supply Lead

Without adequate shielding and filtering, high frequency energy may be fed to the wiring within the installation (mains) by direct coupling. The energy is then transmitted by both radiation and conduction. Adequate shielding and filtering is provided in the Power Source.

Radiation from Welding Leads

Radiated interference from welding leads, although pronounced in the vicinity of the leads, diminishes rapidly with distance. Keeping leads as short as possible will minimize this type of interference. Looping and suspending of leads should be avoided where possible.

Re-radiation from Unearthed Metallic Objects

A major factor contributing to interference is re-radiation from unearthed metallic objects close to the welding leads. Effective grounding of such objects will prevent re-radiation in most cases.

3.04 Specifications

MODEL		160S	
Description		DC STICK/LIFT TIG/HF TIG	
Duty Cycle	TIG	160A / 16.4V @ 35% 130A / 15.2V @ 60% 100A / 14V @ 100% 85A / 13.4V @ 100%	230VAC 230VAC 230VAC 115VAC
	STICK	160A / 26.4V @ 35% 130A / 25.2V @ 60% 100A / 24V @ 100% 50A / 23.4V @ 100%	230VAC 230VAC 230VAC 115VAC
Output Current Range	TIG	1 – 160 (230V), 1 – 85 (115V)	
	STICK	1 – 160 (230V), 1 – 85 (115V)	
Open Circuit Voltage		64V	
Dimensions Width Height Length		 5.12” (130mm) 10.24” (260mm) 12.60” (320mm)	
Weight		18.95 lb. 8.6 kg	
Output @ Rated Load			
Rated Input Voltage		Single Phase 115VAC	Single phase 230VAC
Output Amperes		85A	160A
Output Volts		23.4V	26.4V
Duty Cycle		100%	35%
KVA		4.4	8.7
KW		2.4	5.2
Output @ No Load KVA KW		 0.2 0.1	
Input Volts Single Phase 115V 230V		Amperage Draw @ Rated Load 29 34	No Load 1.5 1.0

Thermal Arc continuously strives to produce the best product possible and therefore reserves the right to change, improve or revise the specifications or design of this or any product without prior notice. Such updates or changes do not entitle the buyer of equipment previously sold or shipped to the corresponding changes, updates, improvements or replacement of such items.
The values specified in the table above are optimal values, your values may differ. Individual equipment may differ from the above specifications due to in part, but not exclusively, to any one or more of the following; variations or changes in manufactured components, installation location and conditions and local power grid supply conditions.

3.05 Duty Cycle

The duty cycle of a welding power source is the percentage of a ten (10) minute period that it can be operated at a given output without causing overheating and damage to the unit. If the welding amperes decrease, the duty cycle increases. If the welding amperes are increased beyond the rated output, the duty cycle will decrease.

WARNING 5

Exceeding the duty cycle ratings will cause the thermal overload protection circuit to become energized and shut down the output until the unit has cooled to normal operating temperature.

CAUTION 1

Continually exceeding the duty cycle ratings can cause damage to the welding power source and will void the manufactures warranty.

NOTE 4

Due to variations that can occur in manufactured products, claimed performance, voltages, ratings, all capacities, measurements, dimensions and weights quoted are approximate only. Achievable capacities and ratings in use and operation will depend upon correct installation, use, applications, maintenance and service.

4.0 OPERATOR CONTROLS

4.01 P-Wee 160S Controls

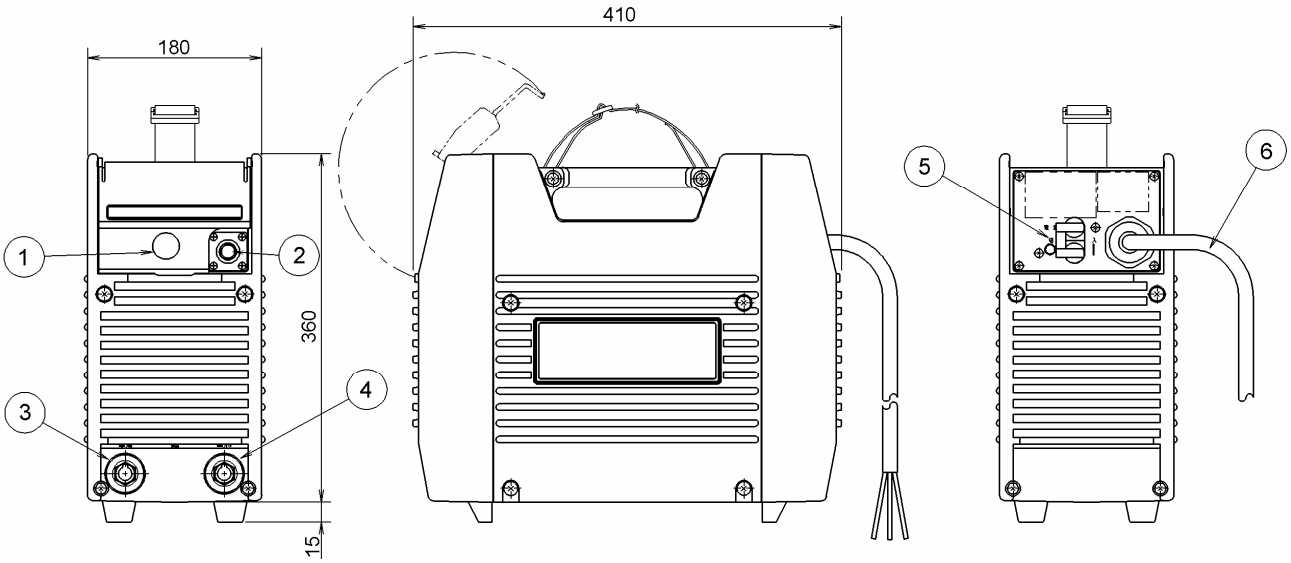


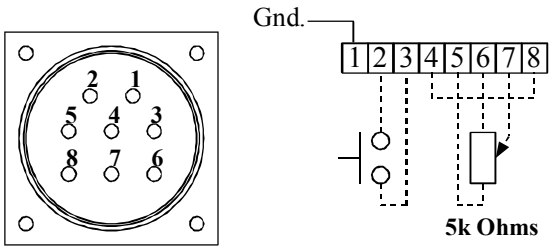
Figure 3 – P-Wee 160S Power Source

1 *Control Knob*

This control sets the selected weld parameter, rotating it clockwise increases the parameter and is indicated on the digital meter. Pushing the knob inward displays the actual welding voltage.

2 *Remote Control Socket*

The 8 pin Remote Control Socket is used to connect remote current control devices to the welding Power Source. To make connections, align keyway, insert plug, and rotate threaded collar fully clockwise.



Front view of 8-Socket Receptacle

Socket Pin	Function
1	Earth (Ground)
2	Torch Switch Input (24V) to energize weld current. (connect pins 2 & 3 to turn on welding current)
3	Torch Switch Input (0V) to energize weld current (connect pins 2 & 3 to turn on welding current)
4	Connect pin 4 to pin 8 to instruct machine that a remote current control device is connected (12V DC supply)
5	5k ohm (maximum) connection to 5k ohm remote control potentiometer
6	Zero ohm (minimum) connection to 5k ohm remote control potentiometer
7	Wiper arm connection to 5k ohm remote control potentiometer
8	Connect pin 4 to pin 8 to instruct machine that a remote current control device is connected (0V)

3 *Positive Terminal*

Welding current flows from the Power Source via heavy duty Dinse type terminal. It is essential, however, that the male plug is inserted and turned securely to achieve a sound electrical connection.

4 *Negative Terminal*

Welding current flows from the Power Source via heavy duty Dinse type terminal. It is essential, however, that the male plug is inserted and turned securely to achieve a sound electrical connection.

CAUTION 2

Loose welding terminal connections can cause overheating and result in the male plug being fused in the bayonet terminal.

5 *ON/OFF Switch*

This switch connects the Primary supply voltage to the inverter when in the ON position. This enables the Power Supply.

WARNING 6

When the welder is connected to the Primary supply voltage, the internal electrical components maybe at 230V potential with respect to earth.

6 *Input Cable*

The input cable connects the Primary supply voltage to the equipment.

4.02 Weld Parameter Description for the 160S

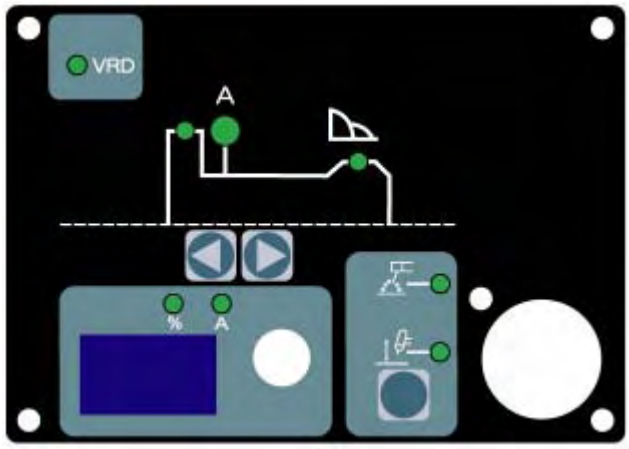


Figure 4. P-Wee 160S Front Panel with Parameter Description

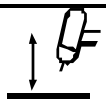
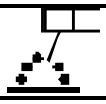
Parameter	Description
HOT START	This parameter operates in STICK weld mode and is used to improve the start characteristics for stick electrodes. e.g. low hydrogen electrodes. It sets the peak start current on top of the *(WELD)* current.
A	Weld Current (Amperage)- sets the STICK and TIG WELD current.
	ARC CONTROL - This parameter provides a suitable short circuit current in STICK welding to improve electrode sticking and arc stability.
	LIFT TIG mode of operation. A remote control device is required for use during LIFT TIG operation. See section 3.01, section 2 "*Remote Control Socket*", for complete details of the remote device.
	STICK Mode of operation.

Table 3 – Weld Parameter Descriptions

4.03 Weld Parameters for the P-Wee 160S

				Weld Mode	
Weld Parameter	**Parameter Range**	**Factory Setting**	**Incremental Unit**	**STICK**	**LIFT TIG**
HOT START	0 to 70A	20A	1A	Yes	No
WELD CUR	5 to 85A 115V 5 to 160A 230V	- 80A	1A 1A	Yes Yes	Yes Yes
ARC CONTROL	0 to 100%	10%	1%	Yes	No

4.04 Power Source Features

Feature	Description
New Digital Control	• Almost all welding parameters are adjustable
Touch Panel Switches	• Touch switches eliminate mechanical damage
Front Control Cover	• Protects front panel controls
Digital Meter	• Displays selected weld parameter value • Displays weld current when welding • Displays weld current for 20 seconds after weld has been completed • A selected weld parameter value can be adjusted at any time even while welding
ON/OFF switch	• Primary voltage Supply ON/OFF switch located on rear panel
Voltage Reduction Device (VRD)	Reduces the OCV when the power supply is not in use. Eliminates the need for add on voltage reducers and has no effect on arc starting. • VRD fully complies to IEC 60974-1 • When Stick mode is selected the green VRD light is ON when not welding and red when welding. • When in TIG modes VRD is off.
Control Knob	• For the selected weld parameter, rotating the knob clockwise increases the parameter • Rotating the knob counterclockwise decreases the parameter • A selected weld parameter value can be adjusted at any time even while welding • Pushing the knob in displays actual arc voltage.
Self Diagnosis Using Error Codes	• An error code is displayed on the *Digital Meter* when a problem occurs with Primary supply voltage or internal component problems. Refer to troubleshooting guide.

5.0 SET-UP FOR SMAW (STICK) AND GTAW (TIG)

Conventional operating procedures apply when using the Welding Power Source, i.e. connect work lead directly to work piece and electrode lead is used to hold electrode. Wide safety margins provided by the coil design ensure that the Welding Power Source will withstand short-term overload without adverse effects. The welding current range values should be used as a guide only. Current delivered to the arc is dependent on the welding arc voltage, and as welding arc voltage varies between different classes of electrodes, welding current at any one setting would vary according to the type of electrode in use. The operator should use the welding current range values as a guide, then finally adjust the current setting to suit the application.

WARNING 7

Before connecting the work clamp to the work and inserting the electrode in the electrode holder make sure the Primary power supply is switched off.

CAUTION 3

Remove any packaging material prior to use. Do not block the air vents at the front or rear or sides of the Welding Power Source.

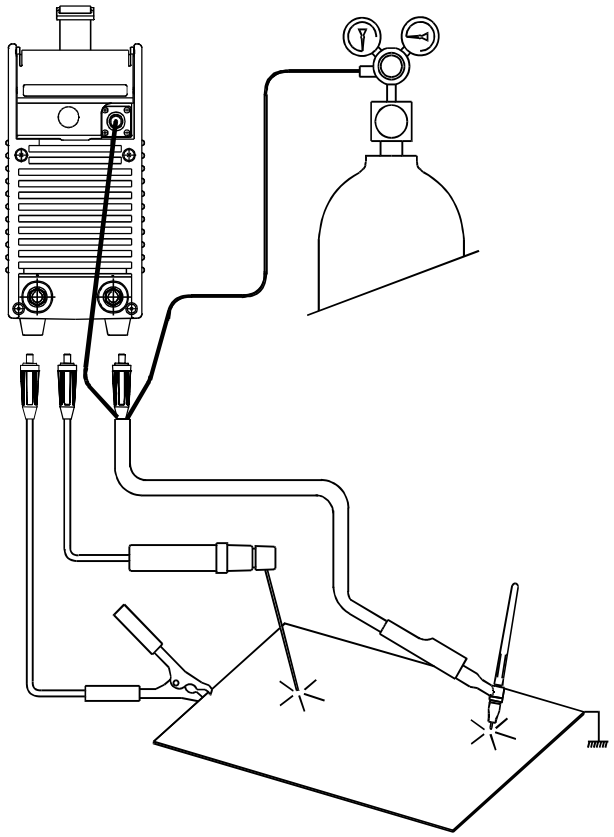


Figure 5 – 160S Set-up

6.0 SEQUENCE OF OPERATION

NOTE: Scroll Buttons are used to select the parameters to be set. The LED's show which function is being adjusted on the weld sequence graph. Refer to Symbols Table located in the front of the manual for Symbol descriptions.

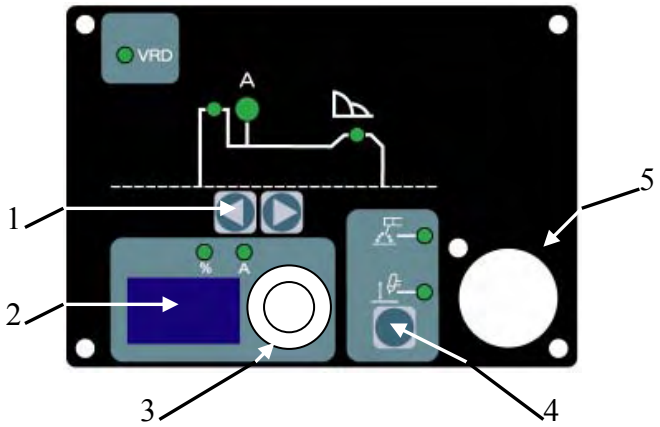


Figure 6 160S Front Panel

1. Scroll Buttons – used to select the parameters to be set. The LED's show which function is being adjusted on the weld sequence graph.
2. Digital LED display – Welding amperage and parameter values are displayed in this window. Internal warnings such as over temperature, low or high input voltage applied are signaled to the operator by a warning sound and error message on the screen.
3. Control knob – allows the operator to adjust the output amperage within the entire range of the power source also used to set each parameter value. Pushing the knob inward displays the actual welding voltage.
4. Process Button – This button selects between STICK or Lift TIG mode.
5. 8 pin remote control receptacle for connecting remote devices. A remote control device is required for use during LIFT TIG operation. See section 4.01, section 2 "*Remote Control Socket*", for complete details of the remote device.

6.01 Stick Welding

- Connect work lead to negative terminal
- Connect electrode lead to positive terminal
- Switch machine on
- Connect remote control device if required

Use the Scroll Buttons to move to the parameter to be set. The LED will show which function is being adjusted on the weld sequence graph. Use the control knob to adjust each parameter.

- Set *HOT START*
- Set *WELD* current
- Set Arc Control

Commence welding

6.02 DC LIFT TIG Welding

- Connect work lead to positive terminal
- Connect TIG torch to negative terminal
- Switch machine on
- Set weld current.
- Connect remote control device. A remote control device is required for use during LIFT TIG operation. See section 4.01, section 2 "*Remote Control Socket*", for complete details of the remote device.

Use the Scroll Buttons to move to the parameter to be set. The LED will show which function is being adjusted on the weld sequence graph. Use the control knob to adjust each parameter.

- Set *WELD* current

Commence welding

7.0 ROUTINE MAINTENANCE

The only routine maintenance required for the power supply is a thorough cleaning and inspection, with the frequency depending on the usage and the operating environment.

WARNING 8

Disconnect primary power at the source before opening the enclosure. Wait at least two minutes before opening the enclosure to allow the primary capacitors to discharge.

To clean the unit, open the enclosure (please refer to the section "Opening the Enclosure"), and use a vacuum cleaner to remove any accumulated dirt and dust. The unit should also be wiped clean, if necessary; with solvents that are recommended for cleaning electrical apparatus.

CAUTION 4

Do not blow air into the power supply during cleaning. Blowing air into the unit can cause metal particles to interfere with sensitive electrical components and cause damage to the unit.

8.0 BASIC TROUBLESHOOTING

WARNING 9

There are extremely dangerous voltages and power levels present inside this product. Do not attempt to open or repair unless you are an Accredited Thermal Arc Service Agent and you have had training in power measurements and troubleshooting techniques.

If major complex subassemblies are faulty, then the Welding Power Source must be returned to an Accredited Thermal Arc Service Agent for repair.

The basic level of troubleshooting is that which can be performed without special equipment or knowledge.

8.01 TIG Welding Problems

Weld quality is dependent on the selection of the correct consumables, maintenance of equipment and proper welding technique.

Description	Possible Cause	Remedy
1 Excessive bead build-up or poor penetration or poor fusion at edges of weld.	Welding current is too low	Increase weld current and/or faulty joint preparation
2 Weld bead too wide and flat or undercut at edges of weld or excessive burn through	Welding current is too high	Decrease weld current
3 Weld bead too small or insufficient penetration or ripples in bead are widely spaced apart	Travel speed too fast	Reduce travel speed
4 Weld bead too wide or excessive bead build up or excessive penetration in butt joint	Travel speed too slow	Increase travel speed
5 Uneven leg length in fillet joint	Wrong placement of filler rod	Re-position filler rod
6 Electrode melts when arc is struck.	A Electrode is connected to the '+' terminal.	A Connect the electrode to the '–' terminal.

Description	Possible Cause	Remedy
7 Dirty weld pool.	A Electrode contaminated through contact with work piece or filler rod material.	A Clean the electrode by grinding off the contaminates.
	B Gas contaminated with air.	B Check gas lines for cuts and loose fitting or change gas cylinder.
8 Electrode melts or oxidizes when an arc is struck.	A No gas flowing to welding region.	A Check the gas lines for kinks or breaks and gas cylinder contents.
	B Torch is clogged with dust.	B Clean torch
	C Gas hose is cut.	C Replace gas hose.
	D Gas passage contains impurities.	D Disconnect gas hose from torch then raise gas pressure and blow out impurities.
	E Gas regulator turned off.	E Turn on.
	F Torch valve is turned off.	F Turn on.
	G The electrode is too small for the welding current.	G Increase electrode diameter or reduce the welding current.
9 Poor weld finish.	Inadequate shielding gas.	Increase gas flow or check gas line for gas flow problems.
10 Arc flutters during TIG welding.	A Tungsten electrode is too large for the welding current.	A Select the right size electrode. Refer to Basic TIG Welding guide.
	B Absence of oxides in the weld pool.	B Refer Basic TIG Welding Guide for ways to reduce arc flutter.
11 Welding arc can not be established.	A Work clamp is not connected to the work piece or the work/torch leads are not connected to the right welding terminals.	A Connect the work clamp to the work piece or connect the work/torch leads to the right welding terminals.
	B Torch lead is disconnected.	B Connect it to the '–' terminal.
	C Gas flow incorrectly set, cylinder empty or the torch valve is off.	C Select the right flow rate, change cylinders or turn torch valve on.

Description	Possible Cause	Remedy
12 Arc start is not smooth.	A Tungsten electrode is too large for the welding current.	A Select the right size electrode. Refer to Basic TIG Welding Guide.
	B The wrong electrode is being used for the welding job	B Select the right electrode type. Refer to Basic TIG Welding Guide
	C Gas flow rate is too high.	C Select the correct rate for the welding job. Refer to Basic TIG Welding Guide.
	D Incorrect shielding gas is being used.	D Select the right shielding gas. Refer to Basic TIG Welding Guide.
	E Poor work clamp connection to work piece.	E Improve connection to work piece.

8.02 Stick Welding Problems

Description	Possible Cause	Remedy
1 Gas pockets or voids in weld metal (Porosity).	A Electrodes are damp.	A Dry electrodes before use.
	B Welding current is too high.	B Reduce welding current.
	C Surface impurities such as oil, grease, paint, etc.	C Clean joint before welding.
2 Crack occurring in weld metal soon after solidification commences	A Rigidity of joint.	A Redesign to relieve weld joint of severe stresses or use crack resistance electrodes.
	B Insufficient throat thickness.	B Travel slightly slower to allow greater build up in throat.
	C Cooling rate is too high.	C Preheat plate and cool slowly.
3 A gap is left by failure of the weld metal to fill the root of the weld.	A Welding current is too low.	A Increase welding current
	B Electrode too large for joint.	B Use smaller diameter electrode.
	C Insufficient gap.	C Allow wider gap.
	D Incorrect sequence.	D Use correct build-up sequence.

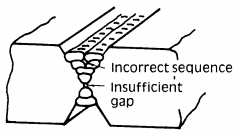


Figure 7 – Example of insufficient gap or incorrect sequence

4 Portions of the weld run do not fuse to the surface of the metal or edge of the joint.	A Small electrodes used on heavy cold plate.	A Use larger electrodes and pre-heat the plate.
	B Welding current is too low.	B Increase welding current
	C Wrong electrode angle.	C Adjust angle so the welding arc is directed more into the base metal
	D Travel speed of electrode is too high.	D Reduce travel speed of electrode
	E Scale or dirt on joint surface.	E Clean surface before welding.

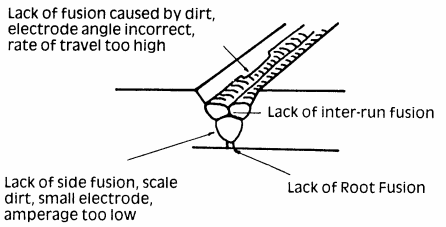
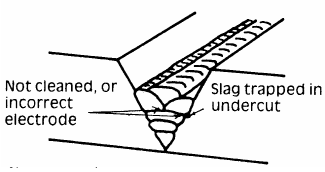


Figure 8 – Example of lack of fusion

5 Non-metallic particles are trapped in the weld metal (slag inclusion).	A Non-metallic particles may be trapped in undercut from previous run.	A If bad undercut is present, clean slag out and cover with a run from a smaller diameter electrode.
	B Joint preparation too restricted.	B Allow for adequate penetration and room for cleaning out the slag.
	C Irregular deposits allow slag to be trapped.	C If very bad, chip or grind out irregularities.
	D Lack of penetration with slag trapped beneath weld bead.	D Use smaller electrode with sufficient current to give adequate penetration. Use suitable tools to remove all slag from corners.
	E Rust or mill scale is preventing full fusion.	E Clean joint before welding.
	F Wrong electrode for position in which welding is done.	F Use electrodes designed for position in which welding is done, otherwise proper control of slag is difficult.



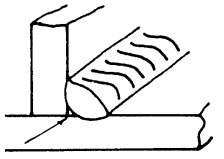


Figure 9 – Examples of slag inclusion

8.03 Power Source Problems

Description	Possible Cause	Remedy
1 The welding arc cannot be established	A The Primary supply voltage has not been switched ON. B The Welding Power Source switch is switched OFF. C Loose connections internally.	A Switch ON the Primary supply voltage. B Switch ON the Welding Power Source. C Have an Accredited Thermal Arc Service Agent repair the connection.
2 Maximum output welding current can not be achieved with nominal Mains supply voltage.	Defective control circuit	Have an Accredited Thermal Arc Service Agent inspect then repair the welder.
3 Welding current reduces when welding	Poor work lead connection to the work piece.	Ensure that the work lead has a positive electrical connection to the work piece.

9.0 VOLTAGE REDUCTION DEVICE (VRD)

9.01 VRD Specification

Description	P-Wee 160S	Notes
VRD Open Circuit Voltage	15.3 to 19.8V	Open circuit voltage between welding terminals
VRD Resistance	148 to 193 ohms	The required resistance between welding terminals to turn ON the welding power
VRD Turn OFF Time	0.2 to 0.3 seconds	The time taken to turn OFF the welding power once the welding current has stopped

9.02 VRD Maintenance

Routine inspection and testing (power source)

An inspection of the power source, an insulation resistance test and an earth resistance test shall be carried out.

a) For transportable equipment, at least once every 3 months; and

b) For fixed equipment, at least once every 12 months.

The owners of the equipment shall keep a suitable record of the periodic tests.

Note 5

A transportable power source is any equipment that is not permanently connected and fixed in the position in which it is operated.

In addition to the above tests and specifically in relation to the VRD fitted to this machine, the following periodic tests should also be conducted by an accredited Thermal Arc service agent.

Description	IEC 60974-1 Requirements
VRD Open Circuit Voltage	Less than 20V; at Vin=115V or 230V
VRD Turn ON Resistance	Less than 200 ohms
VRD Turn OFF Time	Less than 0.3 seconds

If this equipment is used in a location or environment with a high risk of electrocution then the above tests should be carried out prior to entering this location.

10.0 POWER SOURCE ERROR CODES

Description	Possible Cause	Remedy	Remarks
1 E01 error code displayed Temperature sensor TH1 (protects IGBTs) is greater than 80ºC for about 1 second	A The Welding Power Source's duty cycle has been exceeded. B Fan ceases to operate. C Air flow is restricted by vents being blocked	A Let Power Source cool down then keep within its duty cycle. B Have an Accredited Thermal Arc Service Agent investigate C Unblock vents then let Power Source cool down.	Weld current ceases. Buzzer sounds constantly. E01 resets when TH1 decreases to 70ºC for about 30 seconds.
2 E03 error code displayed Primary (input) current too high	A Primary current is too high because welding arc is too long. B Mains supply voltage is more than 10% below nominal voltage	A Reduce length of welding arc. B Have an Accredited Thermal Arc Service Agent or a qualified electrician check for low Mains voltage.	Weld current ceases. Buzzer sounds constantly. Switch machine off then on to reset E03 error.
3 E11 error code displayed Over Primary supply (input) voltage at primary capacitors is exceeded for one second	Primary supply voltage is greater than the nominal voltage plus 10%	Have an Accredited Thermal Arc Service Agent or a qualified electrician check the Primary voltage.	Weld current ceases. Buzzer sounds constantly. Error code E11 automatically will reset when the voltage reduces.

	Description	Possible Cause	Remedy	Remarks
4	E12 error code displayed Under mains supply (input) voltage primary capacitors is reduced for one second	Mains supply voltage is down to a dangerously low level.	A Have an Accredited Thermal Arc Service Agent or a qualified electrician check the Mains voltage B Have an Accredited Thermal Arc Service Agent or a qualified electrician check the primary cable & fuses.	Weld current ceases. Buzzer sounds constantly. Error code E12 automatically will reset when the voltage increases.
5	E93 error code displayed Memory chip (EEPROM) on control PCB can not read/write weld parameters	Memory chip (EEPROM) error	Have an Accredited Thermal Arc Service Agent check the control PCB	Weld current ceases. Buzzer sounds constantly. Switch machine off.
6	E94 error code displayed Temperature sensor TH1 for IGBT's is an open circuit.	The Welding Power Source's temperature sensors have malfunctioned.	Have an Accredited Thermal Arc Service Agent check or replace the temperature sensors.	Weld current ceases. Buzzer sounds constantly. Switch machine off.

11.0 ADVANCED TROUBLESHOOTING

If you are here, all of the troubleshooting suggestions in Section 8-Basic Troubleshooting have either failed to resolve the faulty operation or have indicated that one or more of the subsystems within the power supply are defective. This section provides the information needed to take live measurements on the various subsystems within the power supply, and replace those subsystems that prove faulty.

CAUTION 6

Troubleshooting and repairing this unit is a process, which should be undertaken only by those familiar with high voltage/high power electronic equipment.

WARNING 10

There are extremely dangerous voltage and power levels present inside this unit. Do not attempt to diagnose or repair unless you have training in power electronics, measurement and troubleshooting techniques.

Under no circumstances are field repairs to be attempted on printed circuit boards or other subassemblies of this unit. Evidence of unauthorized repairs will void the factory warranty. If a subassembly is found to be defective by executing any of the procedures in this Service Manual, the subassembly should be replaced with a new one. The faulty subassembly should then be returned to Thermal Arc through established procedures.

WARNING 11

Disconnect primary power at the source before disassembling the power supply. Frequently review the "Important Safety Precautions" in section 1.02. Be sure the operator is equipped with proper gloves, clothing and eye and ear protection. Make sure no part of the operator's body comes into contact with the work piece or any internal components while the unit is activated.

11.01 System-Level Fault Isolation

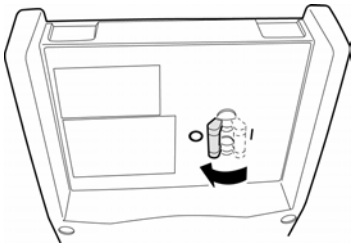
If none of the suggestions provided in Section 8 have solved the problem or corrected the faulty operation, the next step is to isolate one or more of the internal subassemblies that may be defective.

CAUTION 7

Perform all steps in each procedure, in sequence. Skipping portions of procedures, or performing steps out of sequence can result in damage to the unit, and possible injury, or worse, to the operator.

11.01.01 Opening the Enclosure

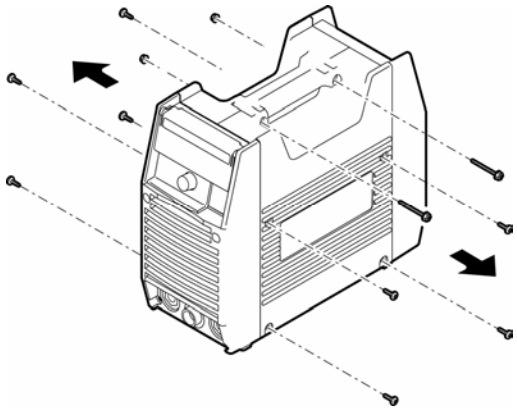
1) Confirm that the switch of power supply and the switch on switchboard (distribution panel) are all OFF.



CAUTION 8

The capacitors inside the power supply will slowly discharged after you turn off the switch of the power supply or the switch at the breaker box (distribution panel). Wait at least 5 minutes for the discharge to complete.

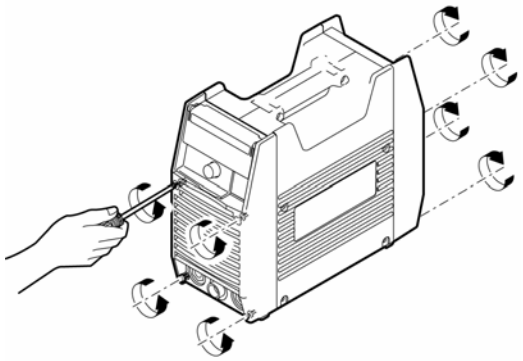
2) Remove all screws and nuts on the side covers.



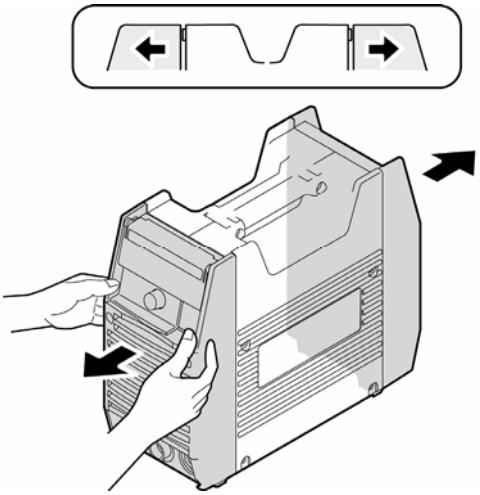
3) Loosen the screws on the front panel and the rear panel by turning them approximately twice.

Note 7

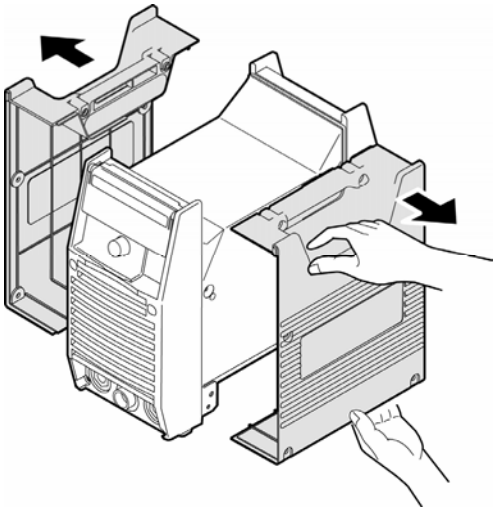
Do NOT remove the screws completely.



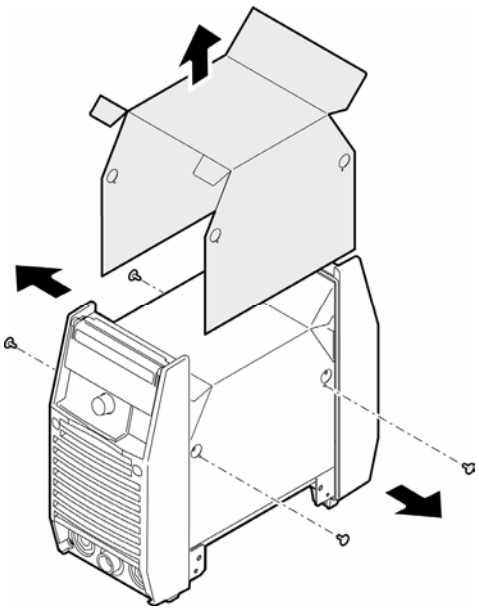
4) Pull the front panel slightly forward and pull the rear panel slightly backward. The interlocking hooks of the side case covers can now be disengaged from the front and rear panels



5) Remove the side covers.



6) Remove protection cover sheet by removing the plastic tabs.



Note 8

When you re-assemble the parts, conduct the above process backwards.

Note 9

The capacitors inside the power supply will slowly discharged after you turn off the switch of the power supply or the switch at the breaker box (distribution panel). Wait at least 5 minutes for the discharge to complete and then remove the cases to continue your inspection and repair (or maintenance) inside the power supply. As for the removal and installation of the case, refer to the illustration on Page 40.

Note 10

During the "**Verification/Remedy**" procedures below, follow the alphabetical sequence (a, b, c…) and proceed with your verification and confirmation.

Note 11

After you confirm and replace all spare parts and components, confirm that there are no damaged harnesses or connectors, uninstalled or loose screws.

1. E85 "Pre-Charge Error"

Cause

Occurs, after you apply power, when a failure is detected during the preliminary charging of the capacitors.

Verification/Remedy

a) Verify the AC input voltage and the Capacitor Bus Voltage on PCB1 (WK-4980).
- Follow the instruction in section 11.01.04.02.

b) Verify the input diode, D1.
- Refer to the section 11.02.06.01 for the test and replacement of D1.

c) Verify the IGBT, Q1.
- Refer to section 11.02.06.02 for the test and replacement of Q1.

d) Replace PCB1 (WK-4980) and PCB2 (WK-4977).
- If the tests in the above sections (a, b, c) are within expected results and the unit is still defective, replace PCB1 and PCB2.
- Refer to section 11.02.04.01 for the replacement of PCB1 and section 11.02.04.02 for the replacement of PCB2.

2. E11 "High Input Voltage Failure"

Cause

Occurs when the input voltage is more than approximately 275VAC (= 1/1.41 of the maximum value of the sinusoidal wave).

Verification/Remedy

e) Verify input voltage.
- Follow the instruction in section 11.01.04.02.

f) Replace PCB2 (WK-4977).
- If the voltage and current available is determined to be sufficient, replace PCB2.
- Refer to section 11.02.04.02 for the replacement of PCB2.

3. E12 "Low Input Voltage Failure"

Cause

Occurs when the input voltage is less than approximately 150VAC (= 1/1.41 of the maximum value of the sinusoidal wave).

Verification/Remedy

a) Verify input voltage.
- Follow the instruction in section 11.01.04.02.

b) Replace PCB2 (WK-4977).
- If the voltage and current available is determined to be sufficient, replace PCB2.
- Refer to section 11.02.04.02 for the replacement of PCB2.

4. E01 (E02) "Over-Temperature at the primary side"

Cause

Occurs when an over-temperature condition of the primary IGBT is detected.

Verification/Remedy

a) Unit may be in thermal shutdown mode.
- Review the rated duty cycle of the unit per section 3.04. Exceeding the duty cycle can damage the unit and void the warranty. Refer also to section 3.05 for additional information.

b) Verify the ventilating condition.
- Maintain a clear and unobstructed distance of more than 30cm in the front and more that 50cm in the rear of the unit for ventilation purposes.
- Verify and maintain clean, dust free, front and rear airflow paths. Cleaning and removing dust from the front and rear panels once every six months in a normal working environment is recommended. Extremely dusty environments will require more frequent cleanings.

c) Verify the operation of the cooling fan, FAN, and replace it if necessary.
- Verify the condition of FAN. Verify that there are no broken or cracked fan blades and that FAN is not producing and abnormal sounds.
- If broken or cracked FAN blades, or abnormal sounds are emanating from FAN, replace FAN.
- Refer to the section 11.02.10 for the replacement of FAN.
- Refer to section 11.01.04.04 for addition FAN tests.

d) Verify the operation of the cooling fan and replace it if the condition of FAN is inactive.
- Follow the instruction in section 11.01.04.04.

e) Replace PCB5 (WK-4986) and PCB6 (WK-4987).)
- Refer to section 11.02.04.04 for the replacement of PCB5 and PCB6

5. E03 "Primary Over-Current Failure"

Cause

Occurs when excessive current is detected flowing into the primary side of the main transformer.

Verification/Remedy

a) Confirm the operation of the machine within the rated specification.
- Refer to the specification data sheet in Section 3.04.

b) Verify the secondary diode (D2 and D3).
- Refer to section 11.02.06.03 for the test and replacement of D2 and D3.

c) Verify the primary IGBT (Q1).
- Refer to section 11.02.06.02 for the test and replacement of Q1.

d) Replace the Hall CT, CT1.

Note 12

Pay special attention to installed direction of CT1. The Hall CT will not function properly if installed in the incorrect direction.

- Refer to section 11.02.09 for the replacement of CT1.

6. E93 "Memory Failure"

Cause

Occurs when the memory fails to save the requested welding parameters.

Verification/Remedy

a) Replace PCB5 (WK-4986) and PCB6 (WK-4987).
- Refer to section 11.02.04.04 for the replacement of PCB5 and PCB6.

7. E94 "Thermistor Failure"

Cause

Occurs when the thermistor for the temperature detection circuitry is open.

Verification/Remedy

a) Verify the wiring harness and connection between CN8 on PCB6 (WK-4987) and thermistors TH1.
- Confirm a secure connection of the harness wired between CN8 on PCB6 and TH1 and re-install the harnesses with a secure connection.
- Contact the manufacturer if you find any broken connectors or damaged wiring harnesses.

b) Replace thermistors, TH1.
- Refer to section 11.02.07 for the replacement of TH1.

c) Replace PCB5 (WK-4986) and PCB6 (WK-4987).
- Refer to section 11.02.04.04 for the replacement of PCB5 and PCB6.

8. E99 "Initial Power Receiving"

Cause

Occurs when the initial AC power received signal has not reached the CPU.

Note 13

This error occurs normally during the power "OFF" sequence of the unit.

Verification/Remedy

a) Verify the wiring harness and connection of CN1 on PCB5 (WK-4986) and CN8 on PCB2 (WK-4977).
- Confirm a secure connection of the harness wired between CN1 on PCB5 and CN8 on PCB2 and re-install the harness with a secure connection.
- Contact the manufacturer if you find any broken connectors or damaged wiring harness.

b) Verify and replace PCB2 (WK-4977).
- Confirm a secure connection of the harness wired between CN13 on PCB1 and CN12 on PCB2 and re-install the harness with a secure connection.
- Refer to section 11.02.04.02 for the replacement of PCB2.

c) Replace PCB5 (WK-4986) and PCB6 (WK-4987).
- Refer to section 11.02.04.04 for the replacement of PCB5 and PCB6.

Refer to ***Note 9*** on Page 41.

Refer to ***Note 10*** on Page 41.

Refer to ***Note 11*** on Page 41.

1. "Cooling Fan Failure" (Fan is not rotating.)

Cause

Occurs when the cooling fan is defective, damaged or the driving voltage is incorrect.

Verification/Remedy

a) Verify the cooling fan, FAN1.
- Inspect the condition of the fan blades and all peripheral parts. Clean the fan blades and all peripheral parts if covered with dust. Cleaning and removing dust from the fan blades once every 6 months in a normal environment is recommended. Extremely dusty environments will require more frequent cleanings.
- Verify that there are no wiring harnesses entangled inside the fan, confirm that the harnesses do not have any brakes in the wire or damaged connectors.
- Contact the manufacture if you find any broken connectors or damaged wiring harnesses.
- Replace the fan if there are any broken, cracked or missing fan blades.
- Refer to section 11.02.10 for replacement of FAN1.

b) Verify the wiring harness between the cooling fan (FAN) and CN3 on PCB2 (WK-4977).
- Confirm a secure connection of the harness to CN3 on PCB2.
- Contact the manufacture if you find any broken connectors or damaged wiring harnesses.

c) Cooling fan voltage tests and replacement of the cooling fan (FAN1).
- Follow the instruction in section 11.01.04.04.

2. "No weld output"

Cause

Occurs when the 8-pin connector or associated circuitry is defective, damaged, or the TIG torch cable is defective.

Verification/Remedy

CAUTION 9

Read and understand this entire section before proceeding. Extreme personal harm and test equipment damage will occur if the procedures are not performed accurately.

a) Verify the 8-pin connector. (Applies to LIFT TIG mode.)
- Confirm a secure connection between CON1 of the 8-pin connector and the remote device.
- Confirm a secure connection of the harness and the connections between CON1 and PCB2 (WK-4977) are all correct and there are no open circuits.
- Contact the manufacture if you find any broken connectors or damaged wiring harnesses.
- Confirm the proper pins-outs of the 8-pin connector on the remote device. (Refer to section 4.01.)
- Confirm that there is no open circuit on the 8-pin connector at TIG Torch side.

b) Verify the condition and connections of the welding cable, the stick rod holders and the ground clamp. (Applies to all welding modes.)
- Confirm a secure connection of the welding cable, stick rod holders, ground clamp and dinse connectors and there are no open circuits.

c) Verify the no-load voltage (OCV). (Applies to STICK mode.)
- Refer to the section "Verification of No-load voltage (No OCV)" in the section 11.01.04.05 first before continuing this section.
- If performing the "No-Load Voltage Failure" procedure does not rectify the failure, perform the following tests in the sequence below. Replace any defective components found.
    1) Diode, D2, D3. (Refer to the Section, 11.02.06.03.)
    2) Reactor, L1. (Refer to the Section, 11.02.08.01.)
    3) Transformer, T1. (Refer to the Section, 11.02.08.02.)
    4) IGBT, Q1. (Refer to the Section, 11.02.06.02.)
    5) Hall CT, CT1. (Refer to the Section, 11.02.09.)

4. "Operating Panel Failure" (LED's do not light properly or welding setting cannot be establish.)

Cause

Occurs when there is a connection failure among PCB4 (WK-4985), PCB5 (WK-4986) and PCB2 (WK-4977) or PCB5 and PCB2 are defective.

Verification/Remedy

a) Verify the harness connection between CN4 on PCB2 (WK-4977) and CN1 on PCB5 (WK-4986).
- Confirm a secure connection of the harness and the connections between CN4 on PCB2 and CN1 on PCB5.
- Contact the manufacture if you find any broken connectors or damaged wiring harnesses.

b) Verify the connection between PCB4 (WK-4985) and PCB5 (WK-4986).
- Confirm that all four connectors between PCB4 and PCB5 are tightly connected.
- Confirm the condition of the pins on the connectors and the connectors themselves, if bent pins or damaged connectors are found, replace the suspected PCB.
- Refer to section 11.02.04.03 for the replacement and installation of PCB4 and section 11.02.04.04 for PCB5 (PCB6, WK-4987).

c) Verify the connection between CN13 on PCB1 (WK-4980) and CN12 on PCB2, (WK-4977).
- Confirm a secure connection between CN13 on PCB1 (WK-4980) and CN12 on PCB2 (WK-4977).

d) Replacement of PCB2 (WK-4977), PCB5 (WK-4986) and PCB6 (WK-4987).
   - Refer to section 11.02.04.02 for the replacement and installation of PCB2 and section 11.02.04.04 for PCB5 and PCB6

11.01.04 Fault Isolation Tests

11.01.04.01 Preparation

The following initial conditions must be met prior to starting any of the procedures in this section (11.01.04).

1) Connect the appropriate input voltage. (Check the data tag on the rear of the power supply for the proper input voltage.)

Note 14

Operate at ALL input voltages as noted on the nameplate on the rear panel when testing the power supply.

2) Close primary power source wall disconnect switch or circuit breaker.

3) Place power supply MAIN CIRCIT SWITCH (S1) on rear of unit in the ON position.

WARNING 12

Dangerous voltage and power levels are present inside this unit. Be sure the operator is equipped with proper gloves, clothing and eye and ear protection. Make sure no part of the operator's body comes into contact with the workpiece or any internal components while the unit is activated.

11.01.04.02 Verification of the Power Input Circuitry.

Refer to ***Note 9*** on page 41.

Refer to ***Note 11*** on page 41.

1) Verify the AC input voltage using an AC voltmeter.
Verify input voltage (Phase-to Phase) using an AC voltmeter. (The capability of the voltmeter should be more than 300VAC). Measure the point between lines U1 and V1 on the input switch, S1.
The location of points U1 and V1on switch S1 are indicated in Figure 10.

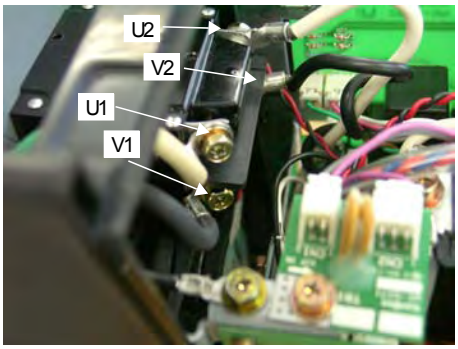


Figure 10 The check points U1, U2, V1 and V2

2) If the input voltage is out of the operating range of the unit, which is ± 10% (103~ 127VAC; 187 ~ 253VAC) of the rated voltage (115; 230V), verify the available power capacity at the installed site.

If the input voltage is within the operating range, recheck the input voltage while welding, as welding may cause the input voltage to decrease to a value below the operating range of the unit.

3) Verify input voltage after the input switch (S1) using an AC voltmeter. (The capability of the voltmeter should be more than 300VAC.)
Using an AC voltmeter, measure between the points U2 and V2 on the input switch, S1. The location of points U2 and V2 on switch S1are indicated in Figure 10.

4) If this voltage is out of the operating range, which is ± 10% (103~ 127VAC; 187 ~ 253 VAC) of the rated voltage (115; 230VAC), replace S1 following the process in section 11.02.05.

5) Verify the rectified output voltage of the input diode, D1 using a DC voltmeter. (The capability of the voltmeter should be more than 400VDC.)
Using a DC voltmeter, measure between the points TB9[+] and of TB11(A)[-] on PCB1 (WK-4980).
Points TB9 and TB11(A) are obtainable on the solder side of PCB1. See Figure 11.
The measured voltage should be approximately 1.4 times larger than input voltage measured in #1 above. Replace diode D1 if the calculated measurement is not within the corresponding range (DC260 ~ 360 V) following the process in section 11.02.06.01.

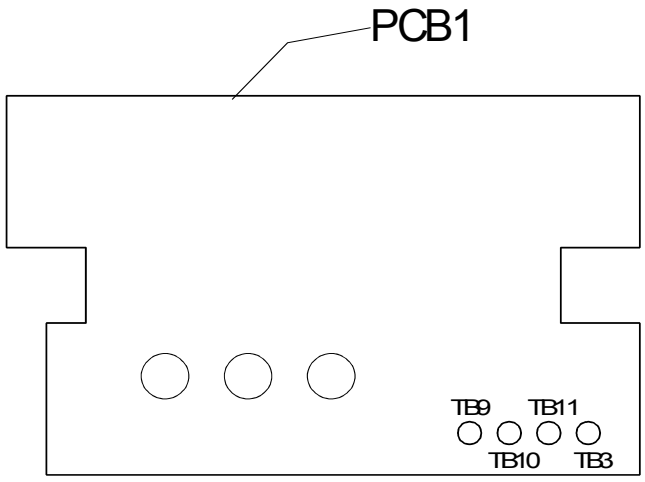


Figure 11 The check points TB9, TB11(A)

6) After the replacement of D1, if the above voltage is still abnormal, replace PCB1 (WK-4980) following the process in section 11.02.04.01.

11.01.04.03 Power Supply Voltage Test

1) Connect the power supply to a source of rated input voltage. (Check the data tag on the rear of the power supply for the proper input voltage.)

Refer to ***Note 14*** on page 48.

2) Apply power to the unit and place the switch of the power supply to the ON position.

3) On the PCB2 (WK-4977), measure the voltages according to the following table. The test point and the reference are obtainable on the solder side of PCB2 (WK-4977).
The location of points for CN4 on PCB2 (WK-4977)[CN4 is circled in Figure 12] are indicated in Figure 12-15.

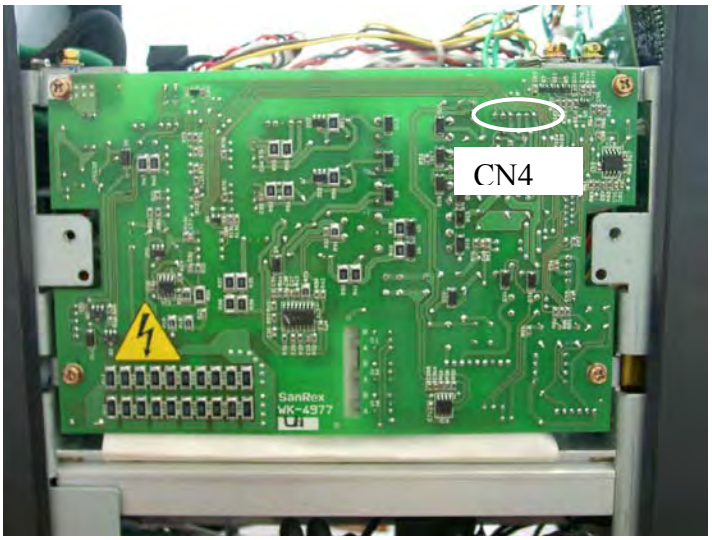


Figure 12 The check points CN4 on PCB2

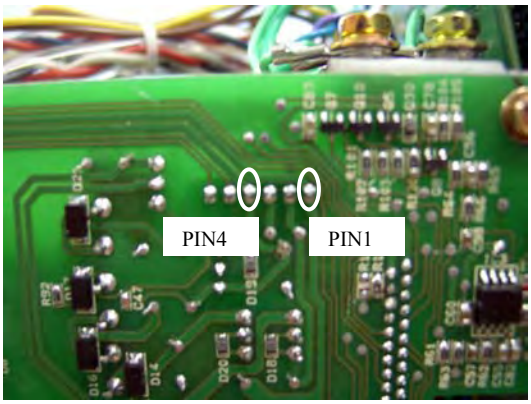


Figure 13 The check points +12V

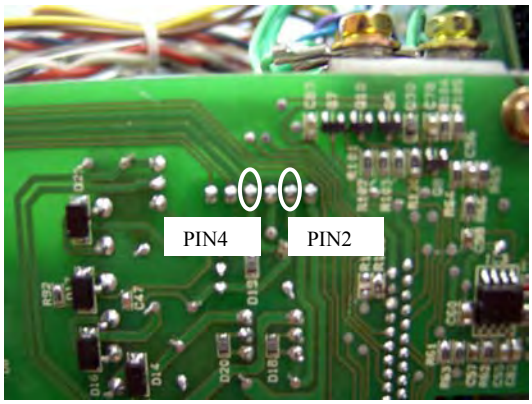


Figure 14 The check points +5V

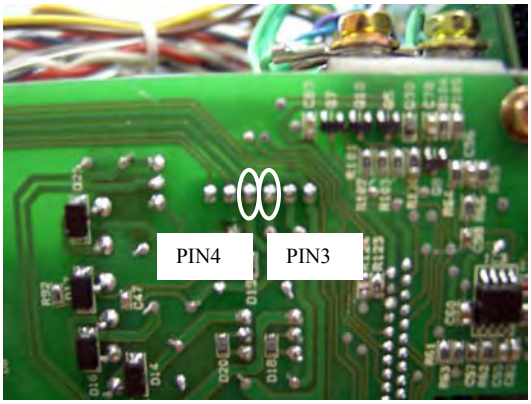


Figure 15 The check points -12V

Test Point (PCB2; WK-4977)	Reference (PCB2; WK-4977)	ACCEPTABLE VALUE
PIN1(CN4)	PIN4(CN4)	+12VDC
PIN2(CN4)	PIN4(CN4)	+5VDC
PIN3(CN4)	PIN4(CN4)	-12VDC

4) If any of these voltages are not present or are below a 10% tolerance, replace PCB2 (WK-4977) following the process in section 11.02.04.02.

11.01.04.04 Verification of the Cooling Fan (FAN1) and Drive Circuitry.

1) Verify the condition of the cooling fan, FAN, using a DC voltmeter. (The capability of the voltmeter should be more than 50VDC.)

Using a DC voltmeter, measure between PIN 1[+] and PIN 2[-] of CN3 on PCB2 (WK-4977).

The location of connector CN3 of PCB2 (WK-4977) is indicated in Figure 16-17.

Note 15

When you measure the above voltage, do not remove the connector. Conduct the measurement while the connector plug and receptacle are still connected.

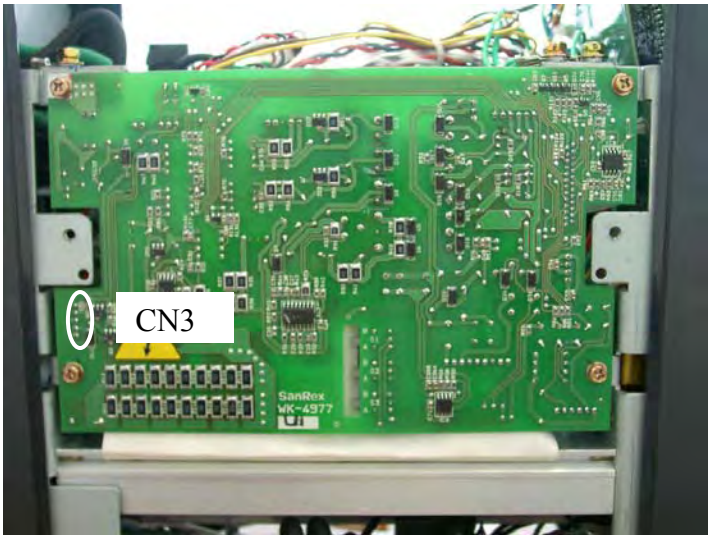


Figure 16 The check points CN3 on PCB2

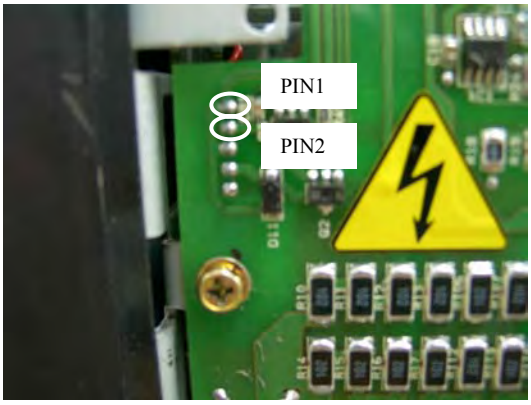


Figure 17 The check points FAN voltage

2) Using the measurement taken above, follow the chart below for possible failure modes.

	Fan Status	**Voltage measurement. (PIN 1 – PIN 2 of CN3 on PCB2)**	**Remedy**
Case 1	Rotating	DC 18 ~ 25V	Fan drive circuit is normal.
Case 2	Rotating	Below DC 18V	Replace PCB2 (WK-4977). (Refer to section 11.02.04.02)
Case 3	Inactive	Below DC 18V	Replace PCB2 (WK-4977). (Refer to section 11.02.04.02) ↓ Conduct the "Verification of the power input circuitry" in section 11.01.02.03.
Case 4	Inactive	DC 18 ~ 25V	Replace the FAN. (Refer to section 11.02.04.10)

Note 16

This welding unit has a feature that will slow the rotational speed of the cooling fan during low output current and while in standby. Under these conditions, the voltages in the above table will be inaccurate; therefore, when verifying the voltage, do so during the failure condition.

Note 17

When verifying the voltage, confirm that the AC input voltage remain within the operating range of the unit.

11.01.04.05 Verification of No-load voltage (No OCV)

a) Verify the no-load voltage in Stick mode.

CAUTION 10

Electric shock hazard. The unit will generate OCV immediately when STICK mode is selected.

1) In STICK welding mode, mark and then place PIN2 of DSW1 on PCB5 (WK-4986) in the OFF position to turn off the electric shock protector function (Voltage-Reduction-Device, VRD).

2) Verify the no-load voltage using a DC voltmeter. (The capability of the voltmeter should be more than 100VDC.)

3) The normal no-load voltage is approximately 62V.

4) Return Pin2 of DSW1 to factory position.

11.01.04.06 Output Load Test

This test verifies that the output current, (amperage) controls are functioning properly. A clamp-type amperage meter or equivalent meter capable of reading approximately 180A full-scale will be needed for this test.

CAUTION 11

Before performing any portion of the procedure below, make certain the unit is placed in the initial set up condition as described at the beginning of this section.

1) Connect the POSITIVE (+) and NEGATIVE (-) OUTPUT TERMINALS to a piece of metal, separated by approximately three feet (one meter).

2) Connect the clamp-on amperage meter or equivalent to the output loop between the POSITIVE (+) and NEGATIVE (-) OUTPUT TERMINALS.

3) Place the power supply PRIMARY POWER SWITCH on the rear of the unit to the ON position.

WARNING 13

This welding mode produces high frequency and high voltage. Extra care shall be taken to prevent electric shock.

4) Select WELD position, press control knob. Set minimum current (counterclockwise).

5) Depress the torch switch. The amperage meter will indicate approximately 5 Amps.

6) Slowly turn the Control Knob clockwise to the maximum of the power supply, then counterclockwise, back to 5 Amps as the control returns to its minimum position. The amperage meter should indicate a continuous range of Amperes between the 5 Amps minimum and the 160A maximum.

7) Set minimum current (counterclockwise).

8) Press the Welding mode selection button to select STICK welding mode. The amperage meter will indicate approximately 5 Amps.

WARNING 14

At this time, some voltage is applied to the stick electrode holder. Never touch the current conducting portion of it. Extra care shall be taken to prevent electric shock. Further, to prevent the risk of striking the arc inadvertently, care shall be taken to keep the work piece to be welded away from the said electrode holder.

9) Slowly turn the Control Knob clockwise to the maximum of the power supply, then counterclockwise, back to 5 Amps as the control returns to its minimum position. The amperage meter should indicate a continuous range of Amperes between the 5 Amps minimum and the 160A maximum.

10) Place the power supply MAIN CIRCUIT SWITCH on the rear of the unit to the OFF position.

11) Remove the dead short between the OUTPUT TERMINALS.

Note 18

This completes the output load test. If the results of any step differ from those above, then refer to the various test procedures in this section to isolate the problem.

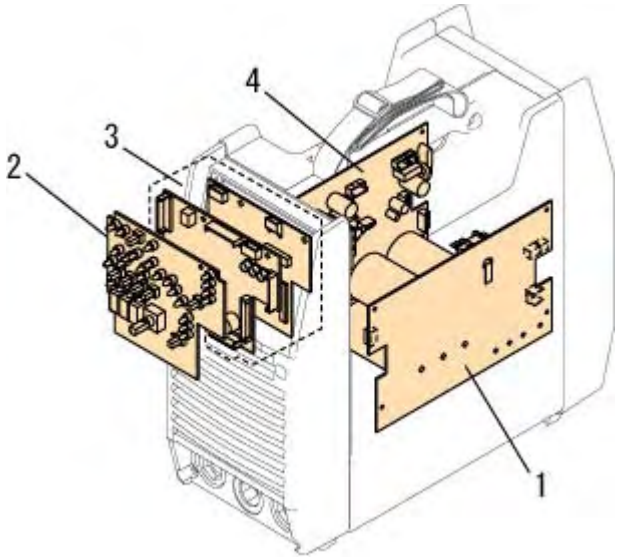
11.02 Subsystem Test and Replacement Procedures

11.02.01 Preparation

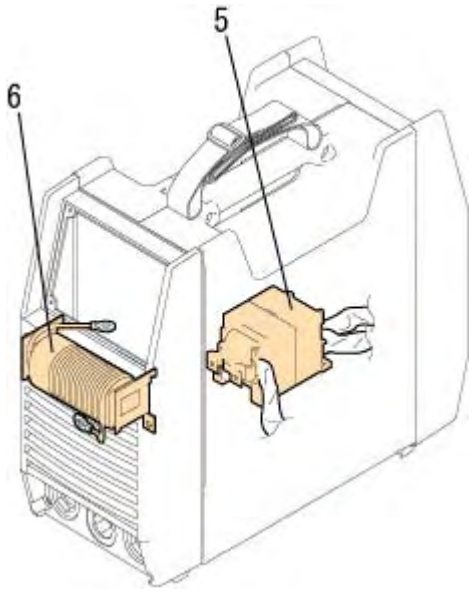
This section provides specific procedures for verifying the operation and replacement of each subsystem within the power supply. Before undertaking any of these procedures, eliminate the obvious first- visually inspect the suspect subsystem for physical damage, overheating, and loose connections.

11.02.02 Test and Replacement Parts List

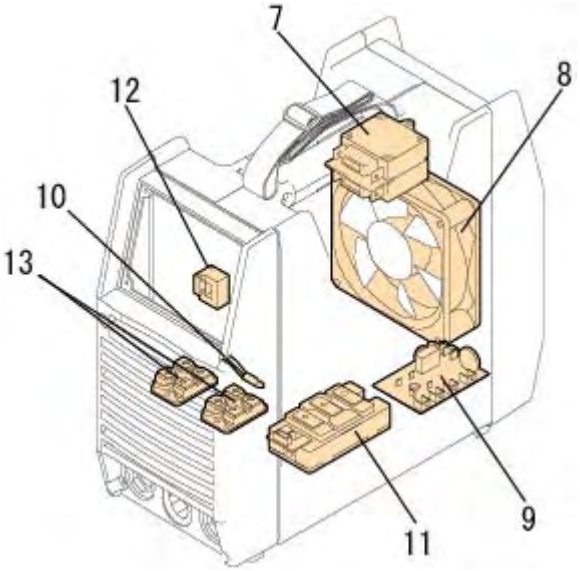
No.	Item Code	Description	Manual Section Number
1	PCB1	Print Circuit Board WK-4980	11.02.04.01
2	PCB4	Print Circuit Board WK-4985	11.02.04.03
3	PCB5	Print Circuit Board WK-4986 (with PCB6) (with Flat Cable)	11.02.04.04
4	PCB2	Print Circuit Board WK-4977	11.02.04.02



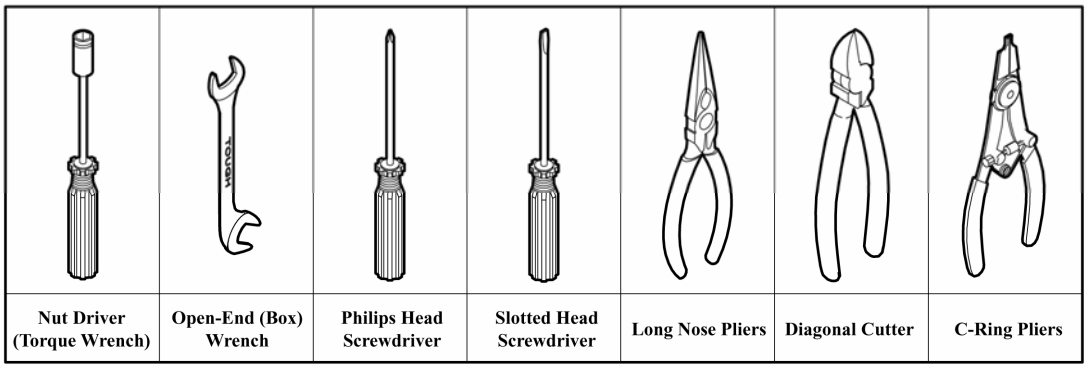
No.	Item Code	Description	Manual Section Number
5	T1	Transformer	11.02.08.02
6	L1	Reactor	11.02.08.01



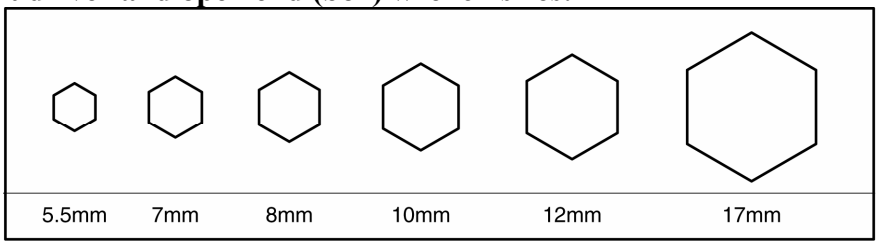
No.	Item	Description	Manual Section Number
7	S1	Switch	11.02.05
8	FAN1	Cooling Fan	11.02.10
9	D1	Diode (with PCB7)	11.02.06.01
10	TH1	Thermistor	11.02.07
11	Q1	IGBT (with PCB3)	11.02.06.02
12	CT1	Hall Current Transformer	11.02.09
13	D2, 3	Diode	11.02.06.03

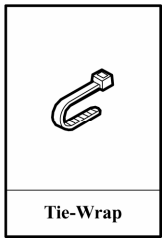


11.02.03 Service Tools



Nut driver and open end (box) wrench sizes:





Note 19

When removing the locking type connectors and board supporters, disengage the locking mechanism first and then disconnect them.

Note 20

Locking type connectors and board supporters are indicated in this manual using the following symbols; black star marks for locking connectors and white star marks for locking board supports.

11.02.04 Print Circuit Boards

11.02.04.01 PCB1Replacement Procedure

1) Remove the side covers. See section “11.01.01”.
2) Remove the three (3) screws (circled as shown in Figure 18) mounting PCB1 on chassis.

Figure 18 PCB1 mounted chassis

3) Remove the screws (4 places at input diode (D1), 3 places at primary IGBT(Q1), 7 places in total) mounting D1 and Q1 on PCB1, as shown in figure 19.

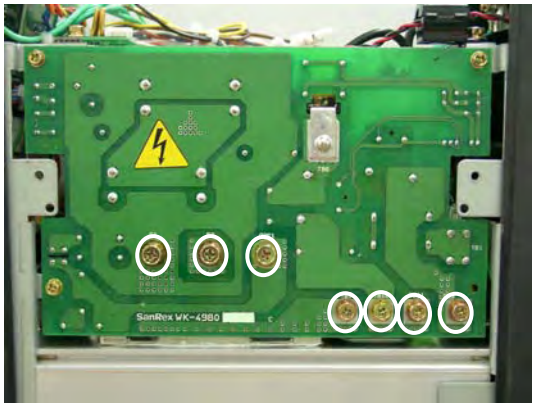


Figure 19 Expanded view of PCB1

4) Remove the screw mounting main transformer (T1) on TB6 at PCB1 (circled as shown in Figure 20) .

Figure 20 PCB1 top view

5) Pull PCB1 out frontward lightly.

Figure 21 PCB1 top view2

6) Unplug a harness connector from CN13 on PCB1.

Figure 22 CN13 on PCB1

7) Unplug harness connectors from CN14 and CN16 on PCB1.

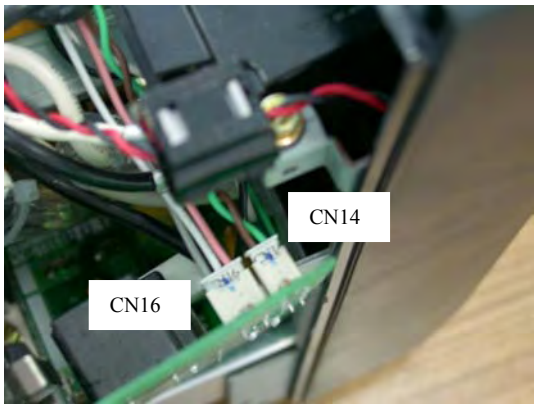


Figure 23 CN14 and CN16 on PCB1

* Holding the upper portion of the harness (to unlock the contact between the harness connector and CN13, CN14, and CN16), pull the harness lightly. To unplug the harness connector, do not pull the harness excessively.

8) Remove the screw mounting S1 with screwdriver, etc, as shown in Figure 25.

Figure 24 Welding equipment with PCB1 pulled out

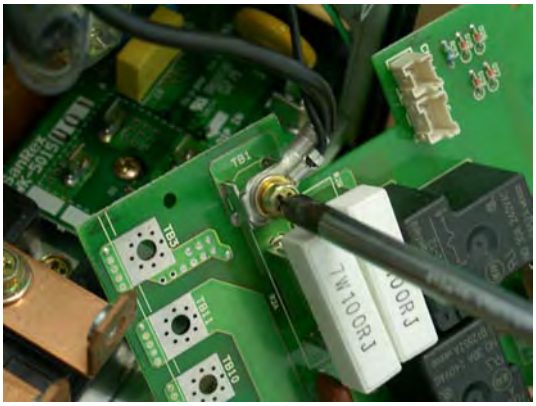


Figure 25 TB1 on PCB1

* When you re-assemble the parts, conduct the above process backwards.

11.02.04.02 PCB2 Replacement Procedure

1) Remove the side covers. See section “11.01.01”.
2) Remove the four (4) screws (circled as shown in Figure 26) mounting PCB2 on chassis.

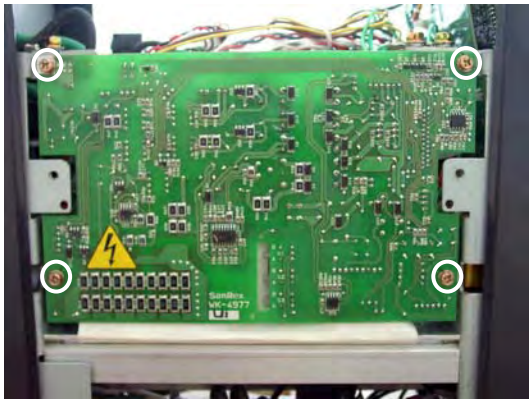


Figure 26 PCB2 mounted on chassis

3) Unplug the harness connectors from CN10 and CN15 on PCB2.

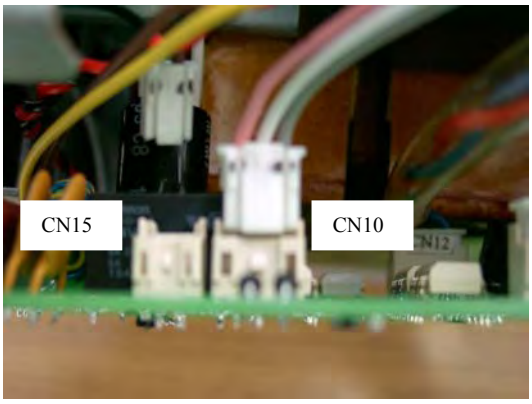


Figure 27 CN15 and CN10 on PCB2

4) Unplug the harness connector from CN9 on PCB2.

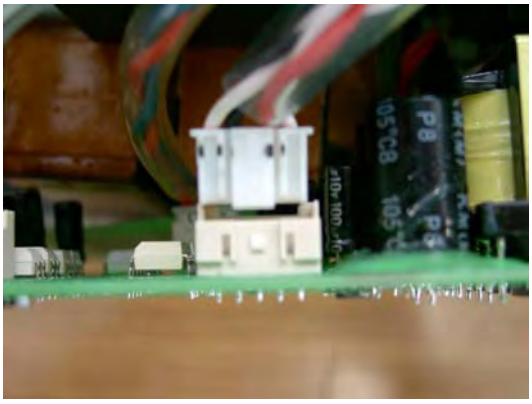


Figure 28 CN9 on PCB2

5) Unplug the harness connector from CN2 on PCB2.

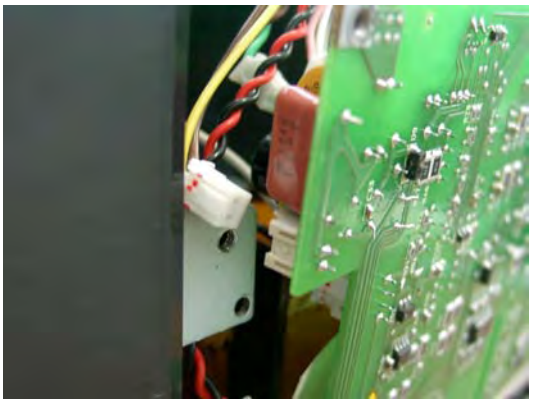


Figure 29 CN2 on PCB2

6) Unplug the harness connector from CN3 on PCB2.

Figure 30 CN3 on PCB2

7) Unplug the harness connector from CN1 on PCB2.

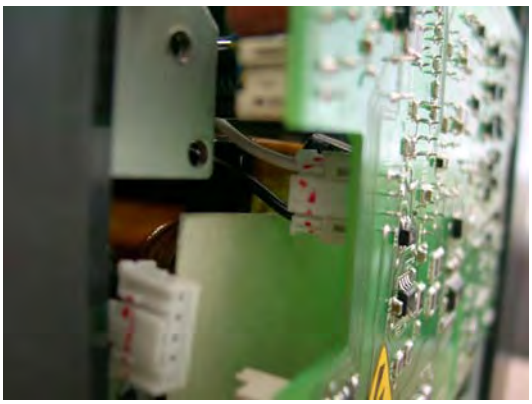


Figure 31 CN1 on PCB2

8) Unplug the harness connector from CN12 on PCB2.

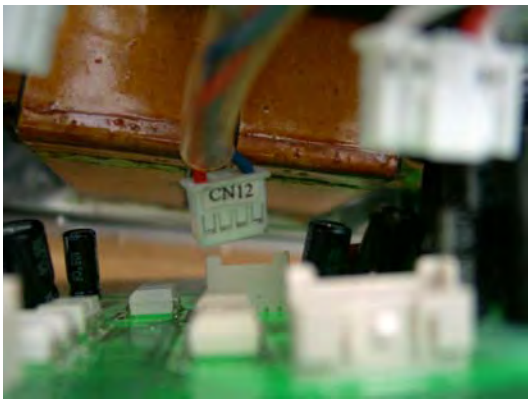


Figure 32 CN12 on PCB2

9) Unplug the harness connector from CN4 on PCB2.

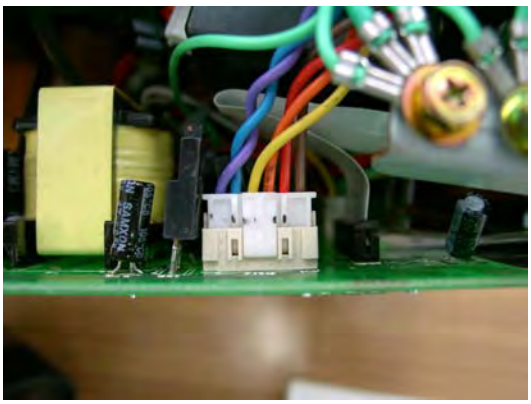


Figure 33 CN4 on PCB2

10) Unplug the harness connector from CN6 on PCB2.

Figure 34 CN6 on PCB2

11) Unplug the harness connector from CN8 on PCB2.

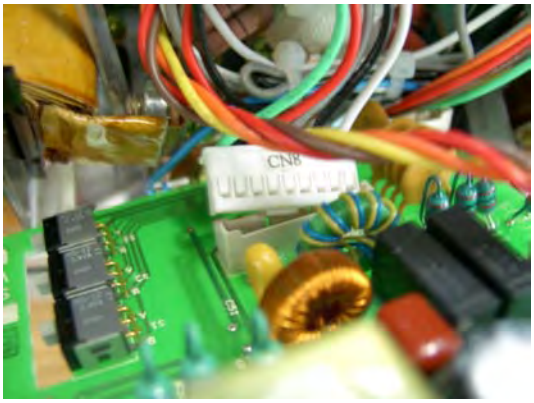


Figure 35 CN8 on PCB2

12) Unplug the harness connector from CN7 on PCB2.

Figure 36 CN7 on PCB2

* Holding the upper portion of the harness (to unlock the contact between the harness connectors and CN1-4, CN6-10, CN12, and CN15), pull the harness lightly. To unplug the harness connector, do not pull the harness excessively.

13) Disconnect a flat cable from CN5 on PCB2.
14) Pull up the retainer bar securing the flat ribbon cable into CN5 (circled as shown in Figure 37).

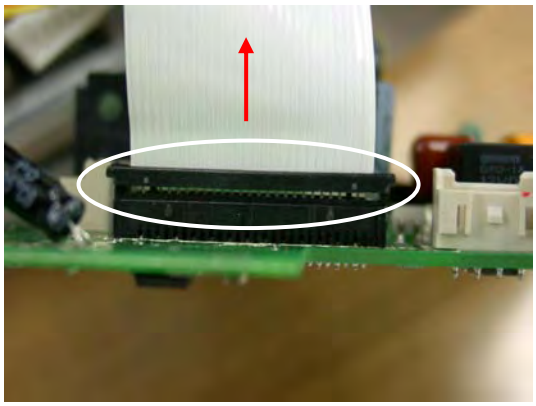


Figure 37 Retainer bar of CN5 on PCB2

15) Disconnect the flat cable from CN5 connector by pulling straight up the cable.

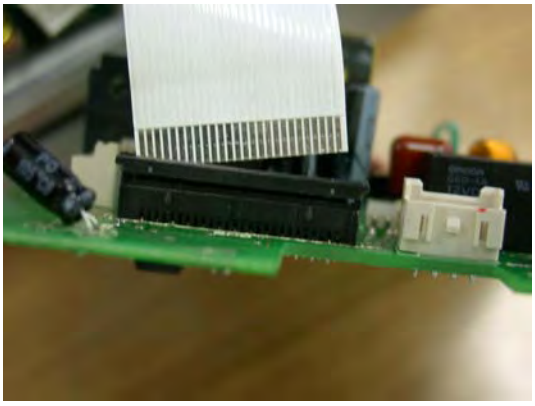


Figure 38 CN5 on PCB2

16) When re-connecting the flat cable, make sure that it is oriented in such a manner that its lug portion is positioned on the front side.

*When you re-assemble the parts, conduct the above process backwards check slide switches (S1, S2, and S3)

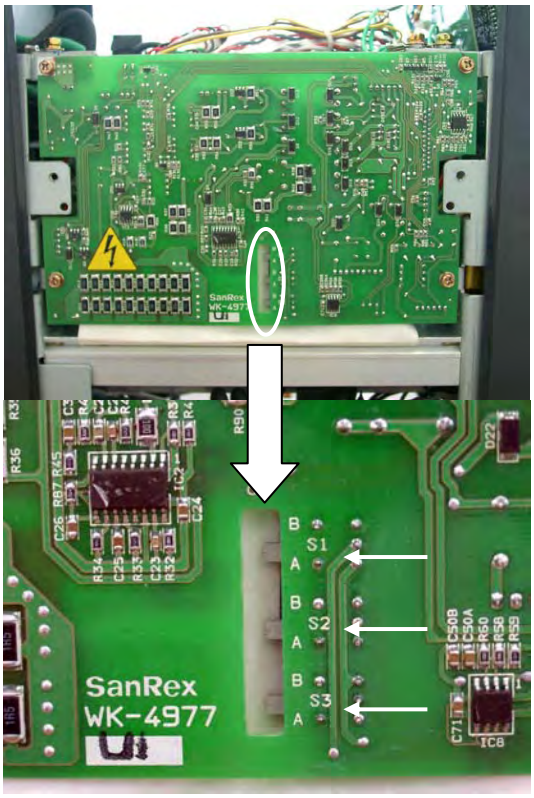


Figure 39 S1, S2, and S3 on PCB2

* Identify locations of slide switches (S1, S2, and S3).
* Make sure that switches S1, S2, and S3 are placed into their respective 'A' positions.

11.02.04.03 PCB4 Replacement Procedure

1) Remove the side covers. See section “11.01.01”.
2) Remove the protection panel cover over the front panel.

Figure 40 Welding equipment front view

Figure 41 Protection panel cover

* To remove the protection panel cover, push both edges of the cover in slightly, as indicated by left and right arrows in Figure 41, and pull the cover frontward.

3) Remove the cap on the control knob (indicated by arrow in Figure 45).

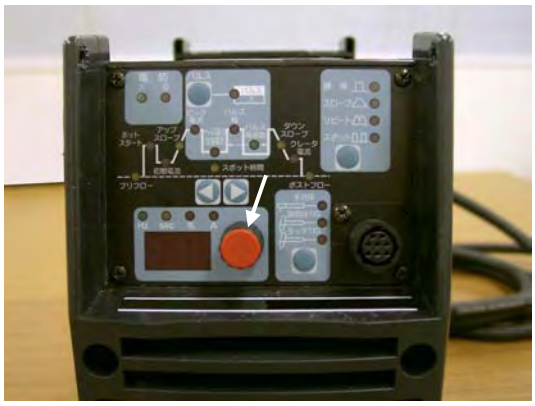


Figure 42 Operation panel

4) Remove screw (indicated by arrow in Figure 43) securing the control knob to the operation panel, loosen the screw and remove the control knob from operation panel.

Figure 43 Control knob

5) Remove the screws (4 places, circled as shown in Figure 44) holding the operation panel onto the front panel.

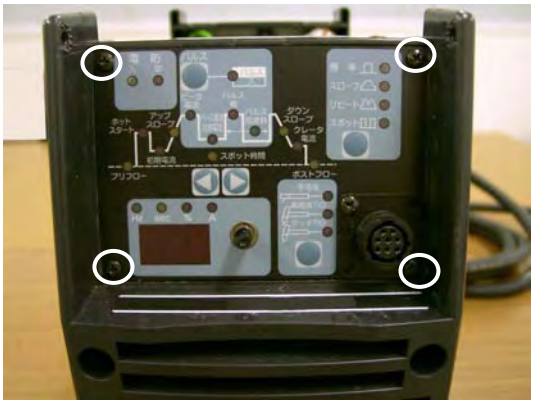


Figure 44 Operation panel with the control knob removed

6) Unplug harness connectors (3 places, circled as shown in Figure 45) from CN1 on PCB5 and from CN8 and CN9 on PCB6.

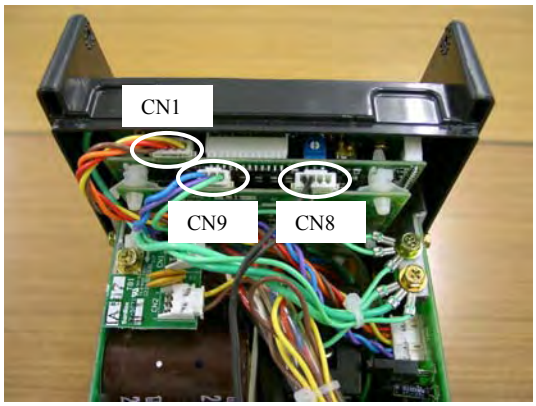


Figure 45 Welding equipment front side top view

7) Pull the operation panel forward out of the front frame.

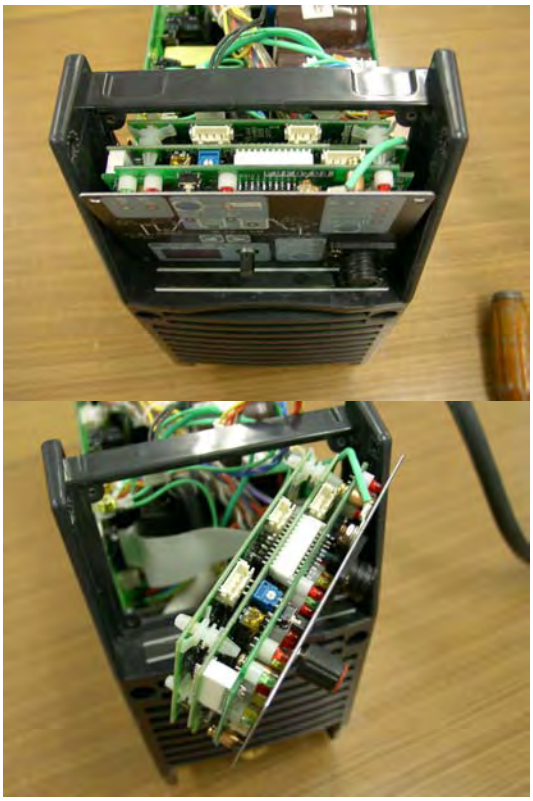


Figure 46 Operation panel frontward

8) Disconnected and remove PCB5 and PCB6 from PCB4 by pulling the two PCB's apart.

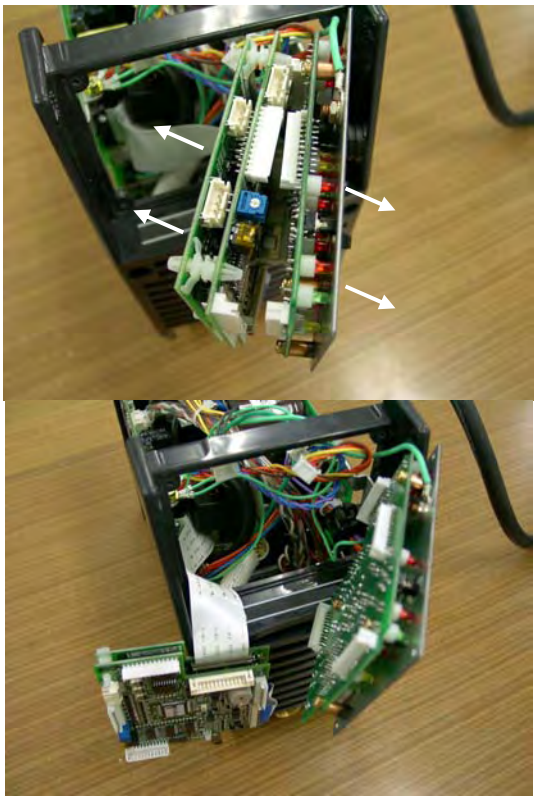


Figure 47 Disassembling the operation panel

9) Remove the screws (4 places, circled as shown in Figure 48) mounting PCB4 on the operation panel sheet.

Figure 48 "B"side view of PCB4

10) Remove the dust cover from the control knob.

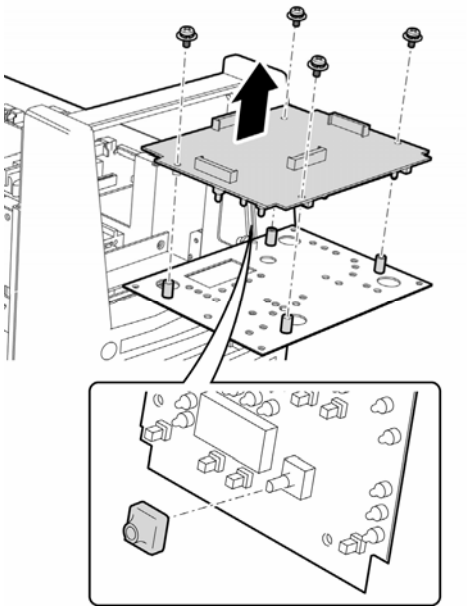


Figure 49 Remove the PCB4

* When you re-assemble the parts, conduct the above process backwards.

11.02.04.04 PCB5 and PCB6 Replacement Procedure

1) Remove the side covers. See section “11.01.01”.
2) Remove the protection panel cover over the front panel.

Figure 50 Welding equipment front view

Figure 51 Protection panel cover

* To remove the protection panel cover, push both edges of the cover in slightly, as indicated by left and right arrows in Figure 51, and pull up the cover frontward.

3) Remove the screws (4 places, circled as shown in Figure 52) holding the operation panel onto the front panel.

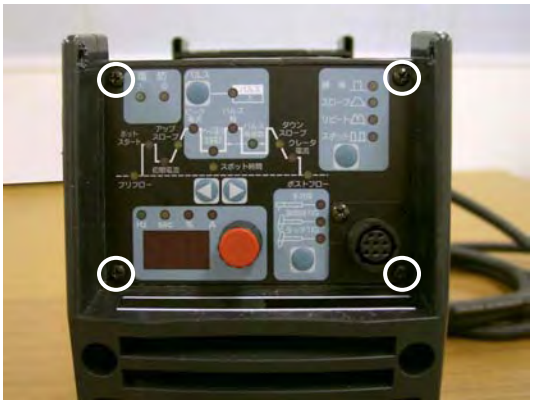


Figure 52 Operation panel

4) Unplug harness connectors (3 places, circled as shown in Figure 53) from CN1 on PCB5 and from CN8 and CN9 on PCB6 .

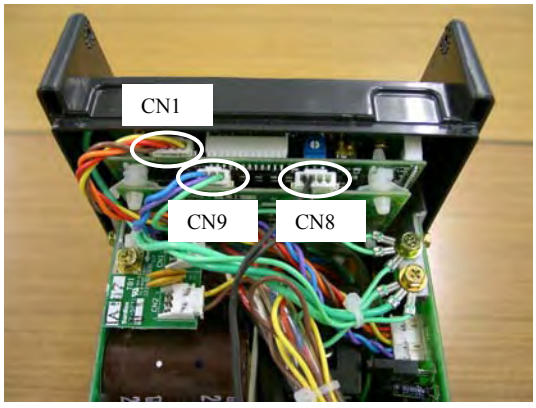


Figure 53 Welding equipment front side top view

5) Pull the operation panel out of the front panel frontward.

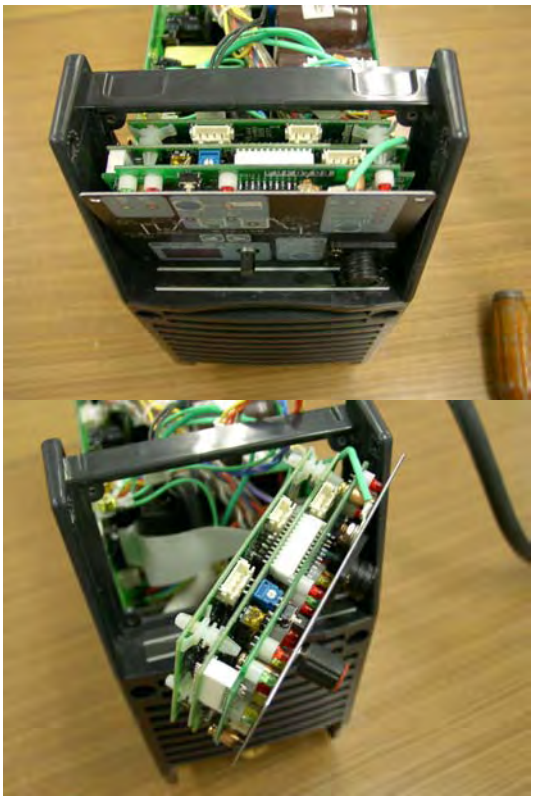


Figure 54 Operation panel frontward

6) Disconnected and remove PCB5 and PCB6 from PCB4 by pulling the two PCB's apart.

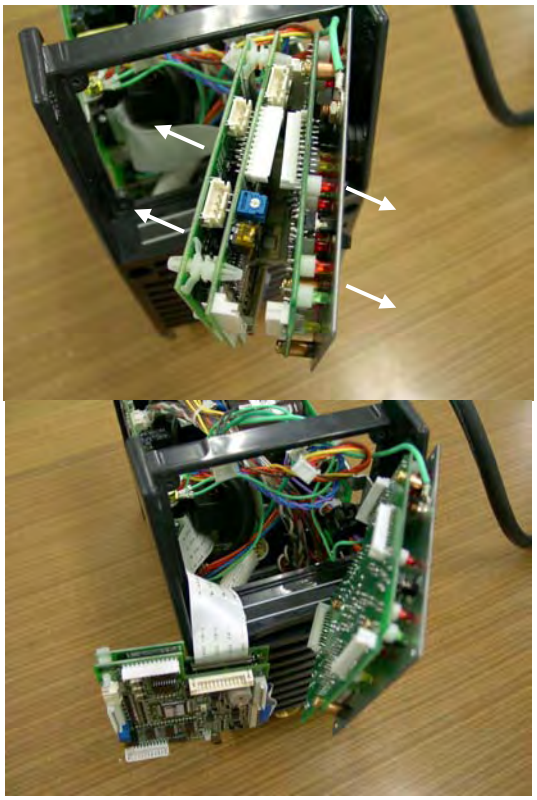


Figure 55 Disassembling the operation panel

7) Remove the retainer plugs (3 places, circled as shown in Figure 56) securing PCB5 to PCB6.

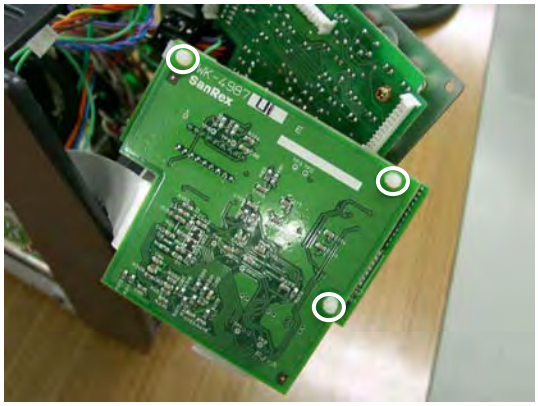


Figure 56 "B"side view of PCB6

8) Disconnect the flat ribbon cable (circled as shown in Figure 57) from PCB6 with PCB5 and PCB6 pulling open and away.

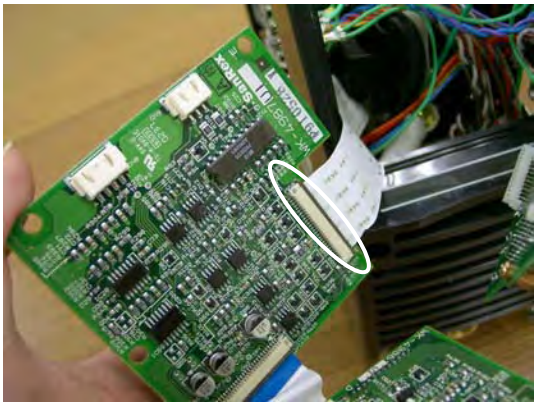


Figure 57 PCB6

9) Pull up the retainer bar securing the flat cable into CN5, (circled as shown in Figure 58)
10) Disconnected and remove PCB5 and PCB6 from PCB4 by pulling the two PCB's apart.
11) Disconnect the flat ribbon cable from CN5 connector by pulling straight up the cable.

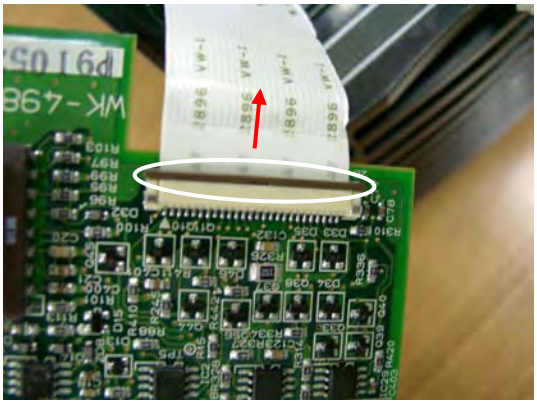


Figure 58 CN5 on PCB6

12) When re-connecting the flat cable, make sure that it is oriented in such a manner that its wire-lead side portion is positioned on the backside, as shown in Figure 58.

* When you re-assemble the parts, conduct the above process backwards.

11.02.05 Switch, S1 Replacement Procedure

1) Remove the side covers. See section “11.01.01”.
2) Remove the screws (4 places, circled as shown in Figure 59) holding the rear panel.

Figure 59 Rear panel

3) Remove the screws (2 places for each, 4 places in total, circled as shown in Figure 60) from the switch along with four lug terminals.

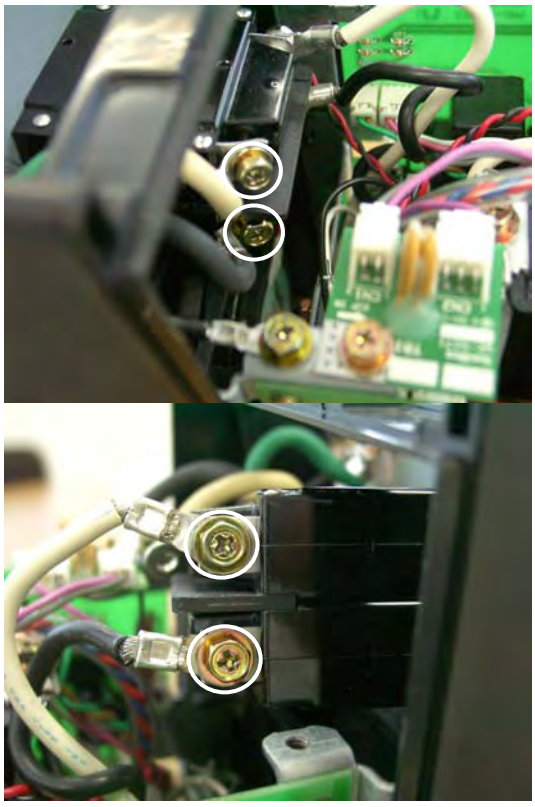


Figure 60 Terminals on S1

4) Remove the two mounting screws and remove the switch.

Figure 61 Screws holding the rear panel

* When you re-assemble the parts, conduct the above process backwards.

11.02.06 Semiconductors

11.02.06.01 Diode, D1

a) Test Procedure

1) Verify the characteristic of the diode, D1 on PCB1, using a diode tester.
2) Refer the Table 6 and Figure 62 for the checkpoints on D1.

COMPONENT TESTED	TERMINALS		ACCEPTABLE VALUE
	Positive lead	Negative lead	
Diode of D1	TB9 TB10	TB10 TB9	0.3 to 0.5V Open circuit
Diode of D1	TB10 TB11	TB11 TB10	0.3 to 0.5V Open circuit

Table 6 D1 tester checkpoints

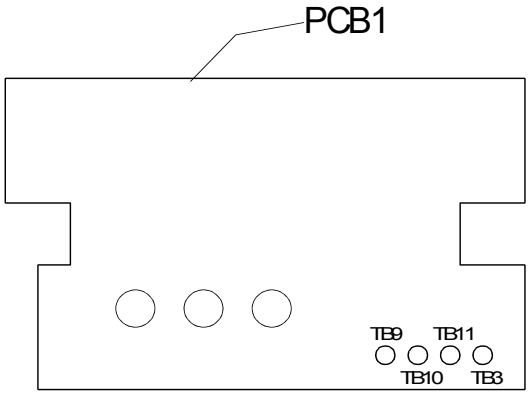


Figure 62 Expanded view of PCB1

b) Replacement Procedure

1) Remove the side covers. See section “11.01.01”.
2) Remove PCB1. See section “11.02.04.01”.
3) Replace D1 together with PCB7.

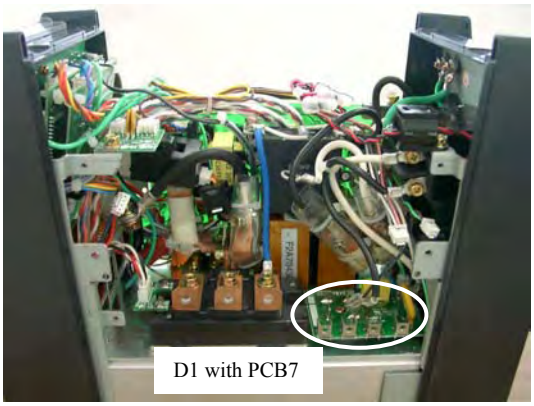


Figure 63 Welding equipment internal view

4) Remove the screw (circled as shown in Figure 64) securing PCB7 to the heatsink.

Figure 64 Expanded view of PCB7

5) Pull out D1 together with PCB7 frontward.

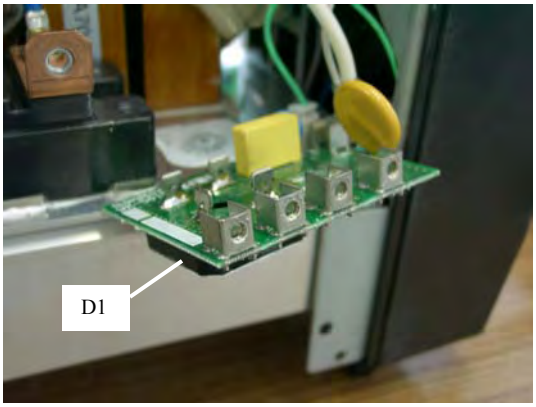


Figure 65 PCB7 and D1

6) Unplug the harness connector from CN1 on PCB7.

Figure 66 CN1 on PCB7

* Holding the upper portion of the harness (to unlock the contact between the harness connector and CN1), pull the harness lightly. To unplug the harness connector from CN1, do not pull the harness excessively.

7) Remove the screw mounting the U-phase input cable lug on TB1 at PCB7, and remove the D1.

Figure 67 TB1 on PCB7

Note 21

When you re-assemble the parts, conduct the above process backwards. Additionally, when installing the diode, apply 23 in·lb to tighten the diode base screws and the terminal screws.

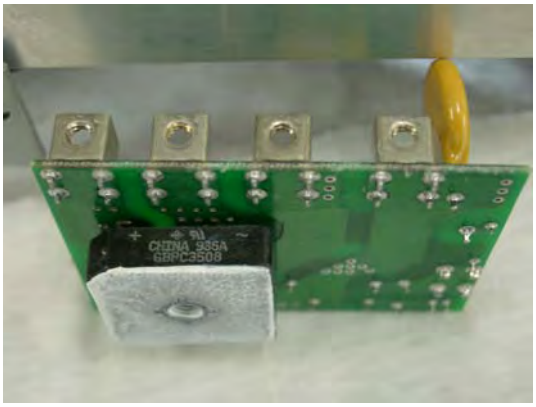


Figure 68 Base surface of D1

Note 22

When replacing the diode, apply heat sink compound (Shinetsu silicon G-747 or equivalent) uniformly to the base surface of the diode.

11.02.06.02 IGBT, Q1

a) Test Procedure

1) Confirm there are no abnormal appearance on PCB3.
2) Verify the characteristic of the IGBT, Q1, using a diode tester.
3) Refer the Table 7 and Figure 69 for the checkpoints on Q1.

COMPONENT TESTED	TERMINALS		ACCEPTABLE VALUE
	Positive lead	Negative lead	
Collector-Emitter of Q1 with PCB3	C1 C2E1	C2E1 C1	Open circuit 0.2 to 0.5V
Collector-Emitter of Q1 with PCB3	C2E1 E2	E2 C2E1	Open circuit 0.2 to 0.5V

Table 7 Q1 tester checkpoints

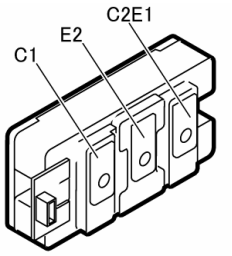


Figure 69 Q1 tester checkpoints

b) Replacement Procedure

1) Remove the side covers. See section “11.01.01”.
2) Remove PCB1. See section “11.02.04.01”.
3) Replace Q1 together with PCB3.

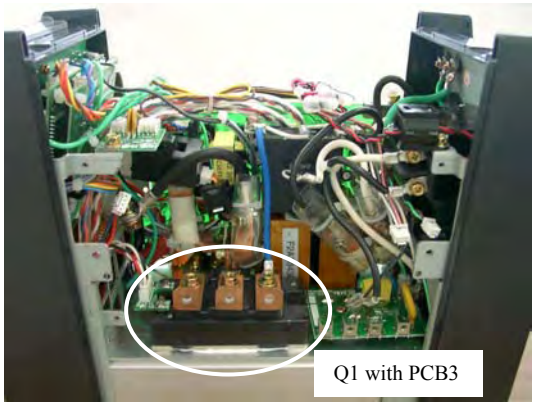


Figure 70 Welding equipment internal view

4) Unplug a harness connector connected to PCB2 from CN1 on PCB3 (circled as shown in Figure 71).

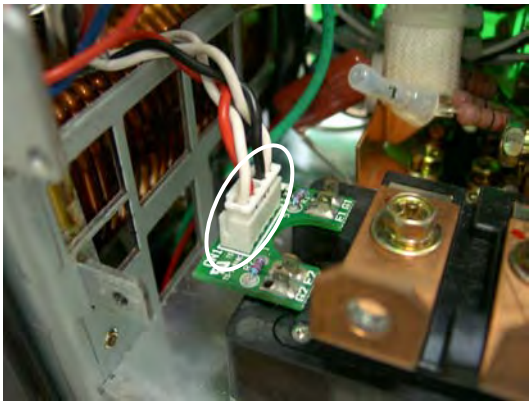


Figure 71 CN3 on PCB3

5) Remove the screw mounting C1 on C2E1 on Q1 (circled as shown in Figure 72).

Figure 72 C2E1 on PCB3

6) Remove the two (2) screws securing Q1 to the heatsink (circled as shown in Figure 73).

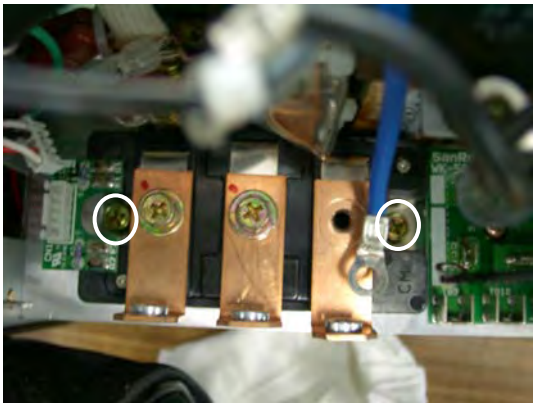


Figure 73 Mounting screws of Q1

7) Remove Q1 from the unit.

8) Remove the two Q bus bar1 mounted on terminals C1 and E2 (circled as shown in Figure 74), and remove from the IGBT.

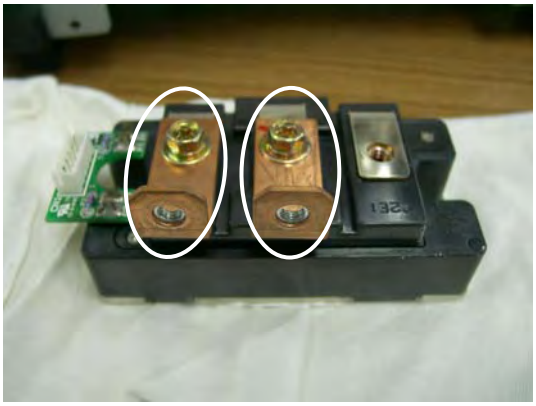


Figure 74 Q bus bar1 on Q1

Note 23

When you re-assemble the parts, conduct the above process backwards. Additionally, when installing the IGBT, apply 27.5 in·lb-force to the IGBT base screws and 23 in·lb-force to the terminal screws.

Figure 75 Base surface of Q1

Note 24

When replacing the IGBT, apply heat sink compound (Shinetsu silicon G-747 or equivalent) uniformly to the base surface of the diode.

11.02.06.03 Diode, D2, D3

a) Test Procedure

1) Verify the characteristic of the diode, D2 and D3 using a diode tester.
2) Refer the Table 8 and Figure 76 for the checkpoints on D2 (D3).

COMPONENT TESTED	TERMINALS		ACCEPTABLE VALUE
	Positive lead	Negative lead	
Diode1 of D2, D3	Anode Cathode	Cathode Anode	0.2 to 0.3V Open circuit
Diode2 of D2, D3	Anode Cathode	Cathode Anode	0.2 to 0.3V Open circuit

Table 8 D2 and D3 tester checkpoints

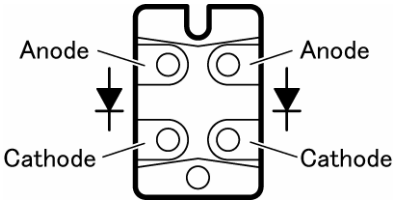


Figure 76 D2(D3) tester checkpoints

b) Replacement Procedure

1) Remove the side covers. See section “11.01.01”.
2) Remove PCB2. See section “11.02.04.02”.

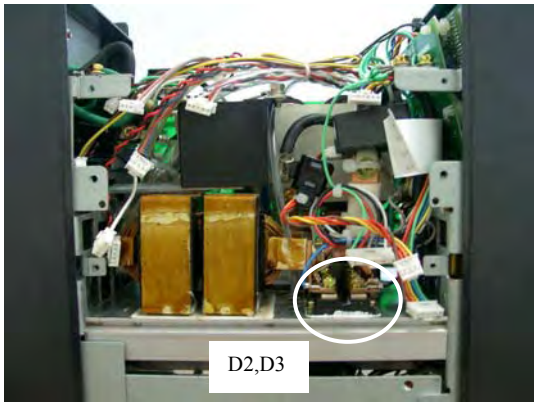


Figure 77 Welding equipment internal view

3) Remove the screws (1 place for each, 2 places in total, circled as shown in Figure 78) mounting T1 on D2 and D3.

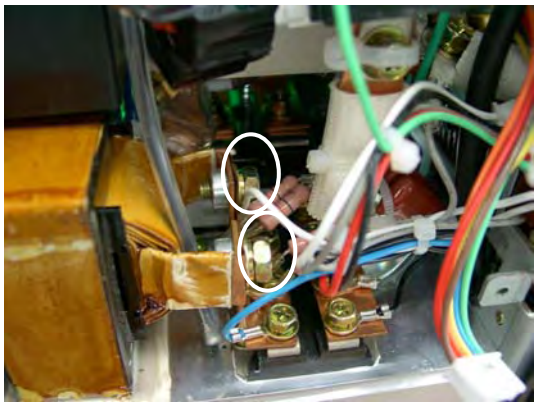


Figure 78 Screws mounting T1

4) Remove the screws mounting bus bars on and connecting snubber resistors to D2 and D3 (4 places for each, 8 places in total, circled as shown in Figure 79).

Figure 79 Screws mounting D2 and D3

5) Remove the mounting screws and then bus bars (circled as shown in Figure 80) from D2 and D3.

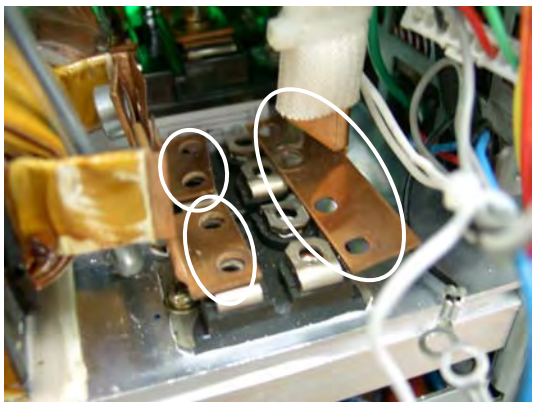


Figure 80 Bud bars on D2 and D3

6) Remove the screws securing D2 and D3 to heatsink (2 places for each, 4 places in total, circled as shown in Figure 81), and remove the D2 and D3.

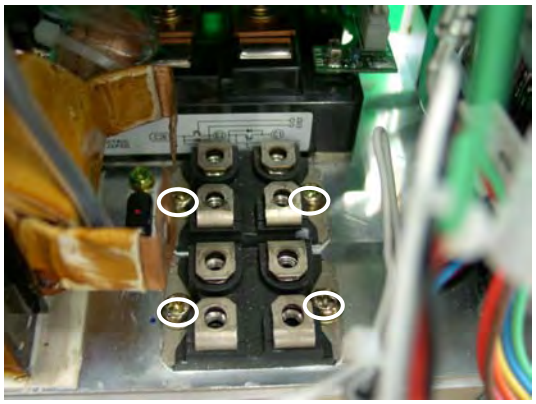


Figure 81 D2 and D3

Note 25

When you re-assemble the parts, conduct the above process backwards. Additionally, when installing the diode, apply 8.85 in·lb force to the diode base screws.

Note 26

Pay attention to the direction of the diode when installing the diode.

Figure 82 Base surface of D2(D3)

Refer to ***Note 22*** on page 86.

11.02.07 Thermistors, TH1

a) Test Procedure

1) Select the Ohms scale on the digital meter.
2) Disconnect the connector at CN8 on PCB6.
3) The resistance of a good sensor measured between pins 1 and 2 on the connector should be in the 10kΩ to 21.6kΩ range, with the reading decreasing as the temperature of the power supply increases. A shorted reading indicates a bad sensor, and it should be replaced.

b) Replacement Procedure

1) Remove the side covers. See section "11.01.01".
2) Remove PCB2. See section "11.02.04.02".
3) Remove the screw (circled as shown in Figure 83) securing TH1 to the heatsink.

Figure 83 TH1

4) Unplug harness connector (circled as shown in Figure 84) from CN8 on PCB6, and remove the TH1.

Figure 84 Welding equipment front side top view

Figure 85 Base portion of TH1

Note 27

When replacing the thermistors, apply heat sink compound (Shinetsu silicon G-747 or equivalent) uniformly to the base surface of the thermistors.

*When you re-assemble the parts, conduct the above process backwards

11.02.08 Coil

11.02.08.01 Reactor, L1

a) Test Procedure

1) Inspect the Reactor, L1, for signs of overheating or loose connections.
2) Check for continuity through the Reactor by measuring between both of the terminals.

b) Replacement Procedure

1) Remove the side covers. See section “11.01.01”.
2) Remove PCB2. See section “11.02.04.02”.
3) Remove the insulating tube applied to the connection between L1 and T1.

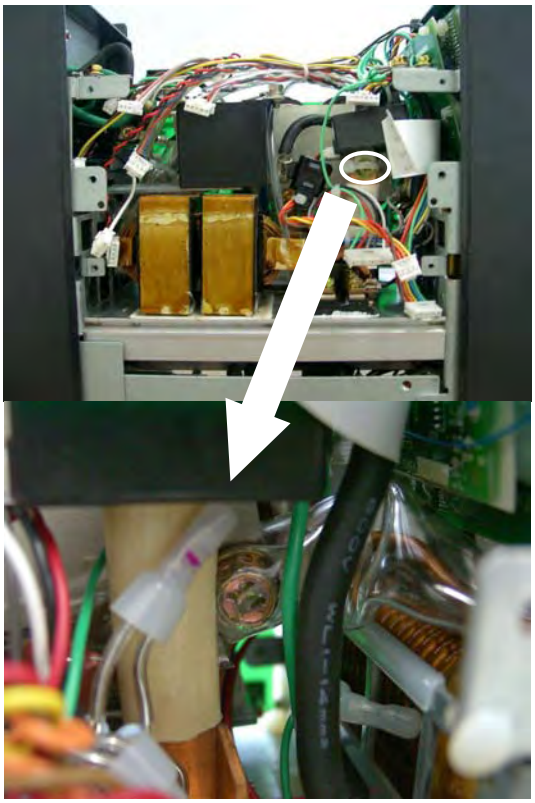


Figure 86 Insulating tube

4) Remove the screw connecting L1 to T1 (circled as shown in Figure 87).

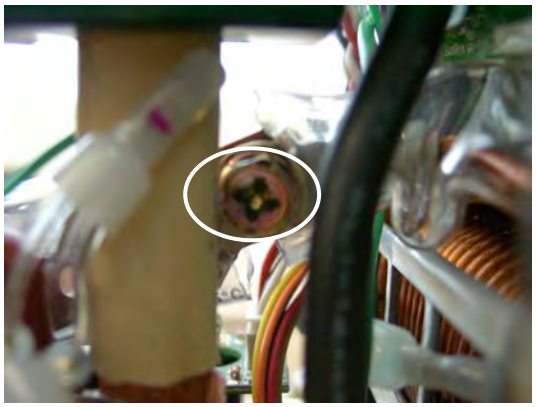


Figure 87 Welding equipment internal

5) Remove the screws (4 places, circled as shown in Figure 88) from the front panel.

Figure 88 Welding equipment front view

6) Remove the screws holding the front panel and then the screws (2 places, circled as shown in Figure 89) mounting the output terminals.

Figure 89 Welding equipment lower front view

7) Remove the front panel from the chassis on the welding equipment.

Figure 90 Removing Front panel

8) Remove the insulating tube applied Remove the screws (2 places, circled as shown in Figure 91) mounting L1 on chassis.

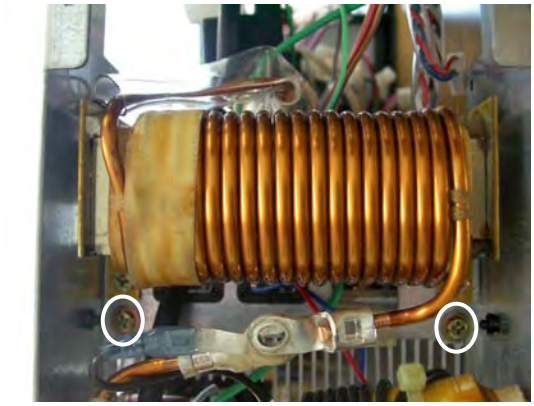


Figure 91 L1

9) Pull L1 out of the power supply, as shown in Figure 92,and remove L1.

Figure 92 Remove L1

* When you re-assemble the parts, conduct the above process backwards.

11.02.08.02 Transformer, T1

a) Test Procedure

1) Inspect the Transformer, T1, for signs of overheating or loose connections.
2) Check for continuity across the primary windings of both transformers.
3) Check for continuity across the secondary windings of both transformers.
4) Check for insulation of between the primary winding and the secondary winding of both transformers.

b) Replacement Procedure

1) Remove the side covers. See section “11.01.01”.
2) Remove PCB1. See section “11.02.04.01”.

Figure 93 Welding equipment internal view

3) Remove the insulating tube applied to the connection between T1 and C1.

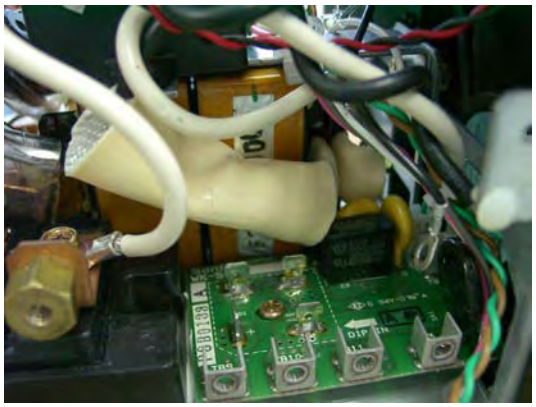


Figure 94 Insulating tube

4) Remove the screw connecting T1 to C1 (circled as shown in Figure 95).

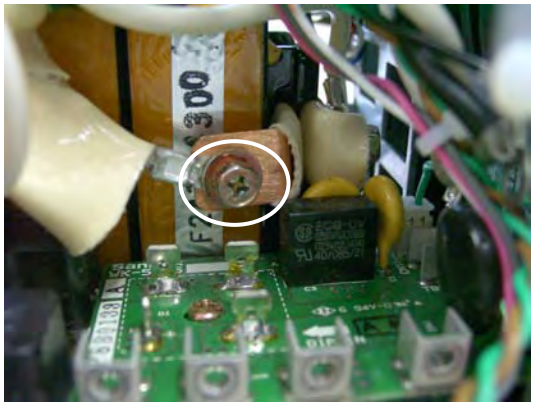


Figure 95 Connecting T1 to C1

5) Remove PCB2. See section “11.02.04.02.

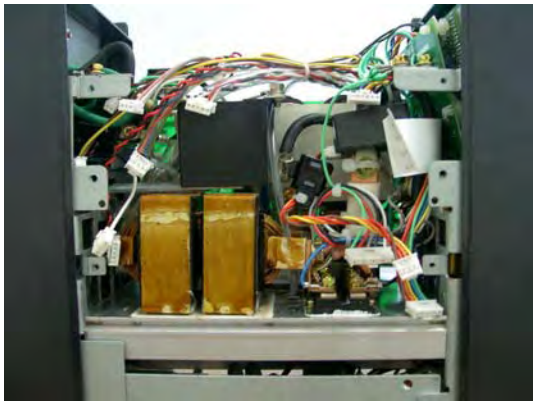


Figure 96 Welding equipment internal view

6) Remove the screws (1 place for each, 2 places in total, circled as shown in Figure 97) mounting T1 on D2 and D3.

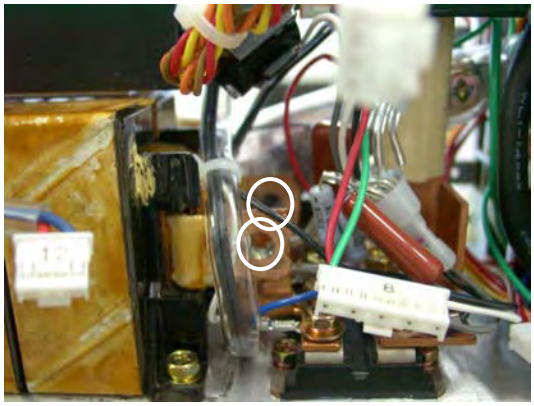


Figure 97 Screws mounting T1

7) Remove the insulating tube applied to the connection between L1 and T1.

Figure 98 Insulating Tube

8) Remove the screw connecting L1 to T1 (circled as shown in Figure 99).

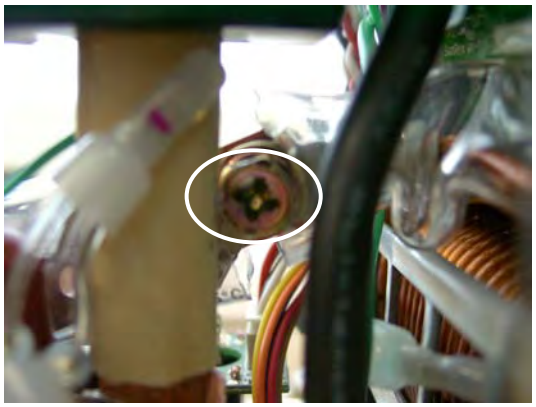


Figure 99 Welding equipment internal

9) Remove the screw connecting C1 to E1C2 of Q1 (circled as shown in Figure 100).

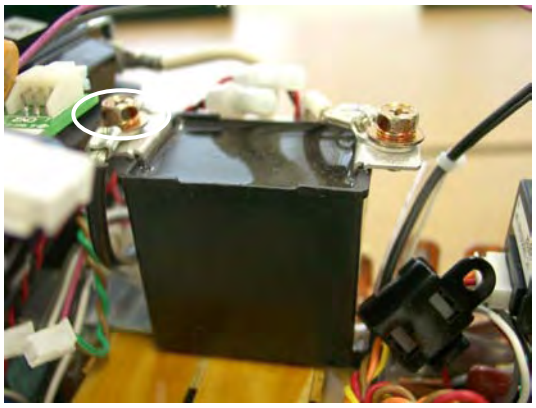


Figure 100 C1

10) Remove the screws (4 places, circled as shown in Figure 101) securing chassis to the rear panel.

Figure 101 Welding equipment rear side

11) Remove the rear panel from the power supply.

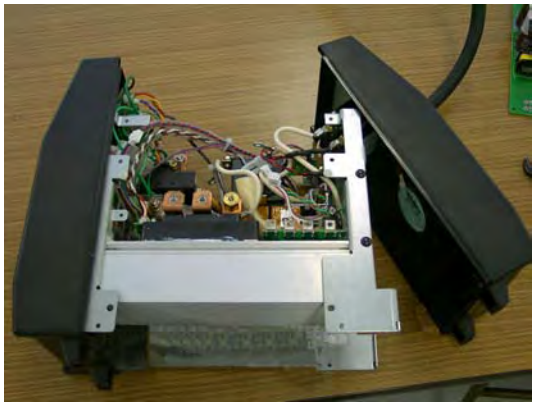


Figure 102 Welding equipment with the rear panel removed

12) Remove the screws (2 places, circled as shown in Figure 103) mounting C1 on chassis.

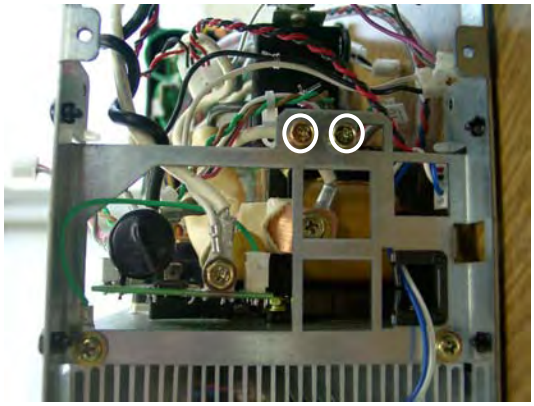


Figure 103 Welding equipment internal rear view

13) Remove the screw connecting T1 to TB6 of PCB1 (circled as shown in Figure 104).

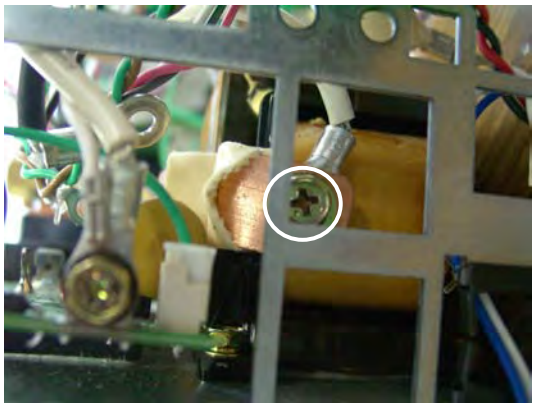


Figure 104 Expanded rear view welding equipment

14) Remove the screws (4 places, circled as shown in Figure 105) mounting T1 onto the chassis, and remove the T1.

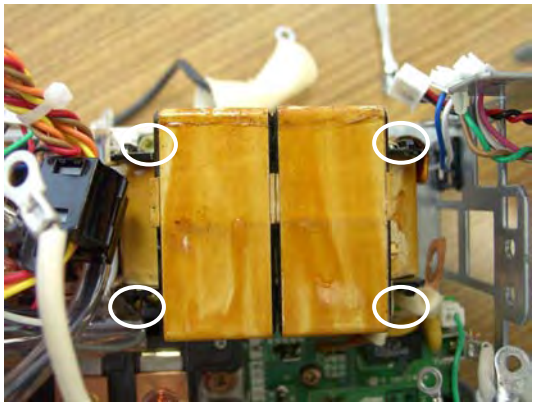


Figure 105 T1 top view

* When you re-assemble the parts, conduct the above process backwards.

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11.02.09 Hall Current Transformer (HCT), CT1

a) Test Procedure

1) Remove the locking connector CN7 attached to PCB2.
2) With an Ohmmeter set the R×10 scale, measure between the pins on the CN7 plug as follows:

Pin 4 and Pin 1 about 3 to 5 MΩ
Pin 4 and Pin 2 about 10 kΩ

b) Replacement Procedure

1) Remove the side covers. See section "11.01.01".
2) Remove PCB2. See section "11.02.04.02.
3) Remove the screw (circled as shown in Figure 106) connecting L1 to the diode bus bar on D2 and D3.

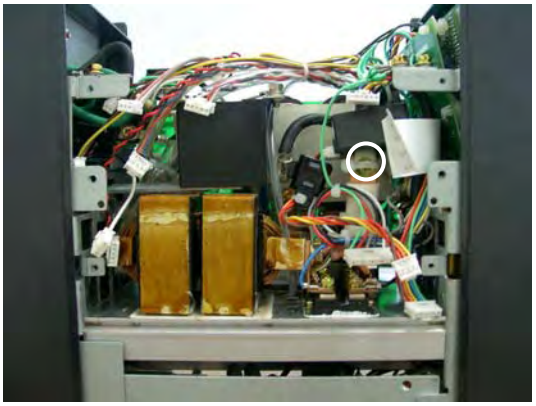


Figure 106 Welding equipment internal view

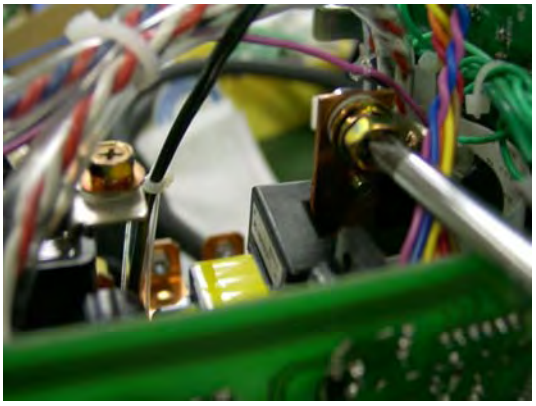


Figure 107 CT1 top view

4) Unplug the harness connector from CT1 from CN7 on PCB2 (circled as shown in Figure 108).

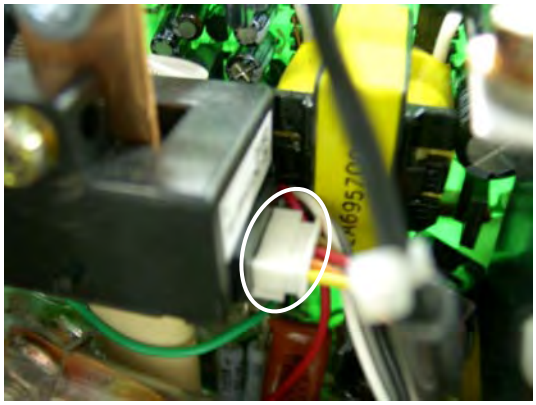


Figure 108 CT1 top view

5) Remove the screw (circled as shown in Figure 109) mounting CT1 on the diode bus bar on D2 and D3, and remove the CT1.

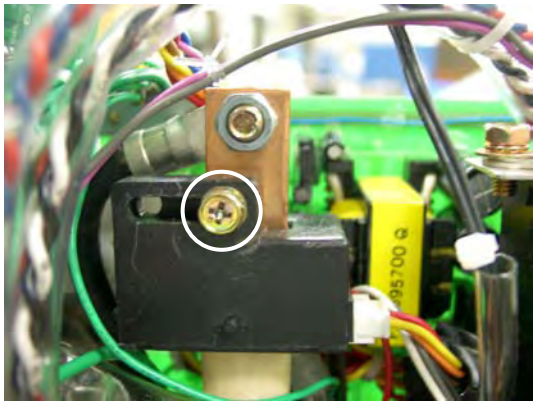


Figure 109 Diode bus bar and screw mounting CT1

Note 28

When you re-assemble the parts, conduct the above process backwards. When installing CT1, be sure it is orientated properly, as shown in Figure 110.

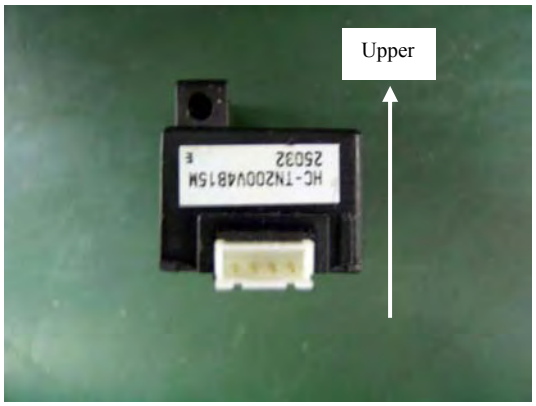


Figure 110 Direction of CT1

11.02.10 FAN1 Replacement Procedure

1) Remove the side covers. See section “11.01.01”.
2) Remove the screws (4 places, circled as shown in Figure 111) securing chassis to the rear panel.

Figure 111 Welding equipment rear side

3) Remove the rear panel from the welding equipment.

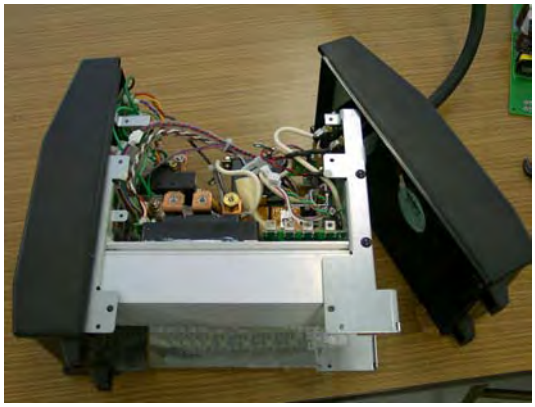


Figure 112 Welding equipment with the rear panel removed

4) Unplug the harness connector from CN3 on PCB2, and remove the FAN1.

Figure 113 CN3 on PCB2

Note 29

When you re-assemble the parts, conduct the above process backwards. When installing FAN, be sure it is orientated properly, as shown in Figure 114.

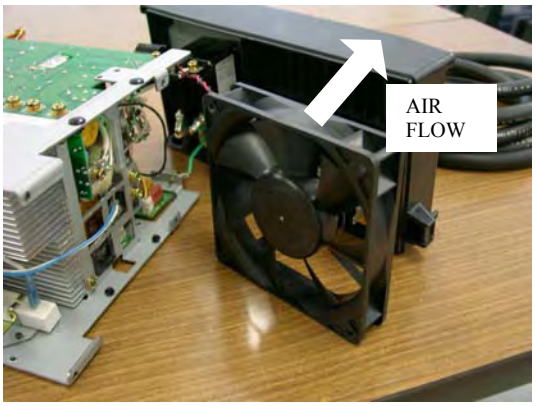


Figure 114 FAN

12.0 SEQUENCE TIMING DIAGRAMS

12.01 STICK Mode

12.01.01 STICK with VRD DISABLED (Voltage Reduction Device)

Figure 115 shows the STICK timing waveforms with the VRD control DISABLED. Place Pin2 of DSW1 on PCB5 (WK-4986) in OFF position to turn off the VRD.

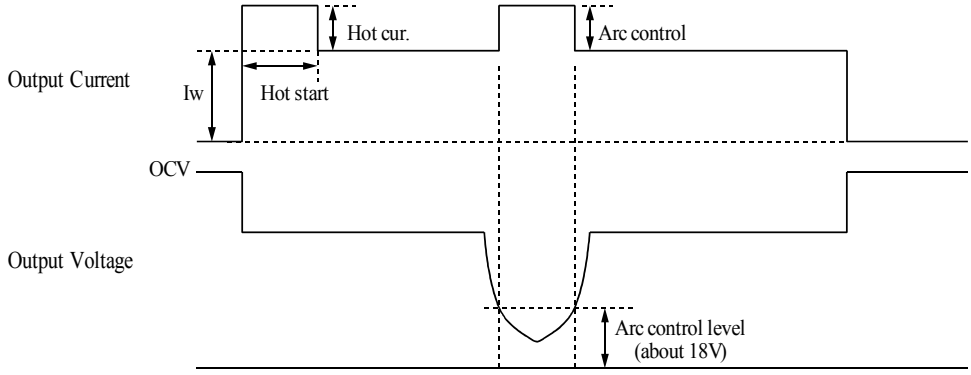


Figure 116 STICK mode timing with the VRD DISABLED

12.01.02 STICK with VRD ENABLED (Voltage Reduction Device)

Figure 116 shows the STICK timing waveforms with the VRD function ENABLED. Place Pin2 at DSW1 on PCB5 (WK-4986) in ON position to turn on the VRD.

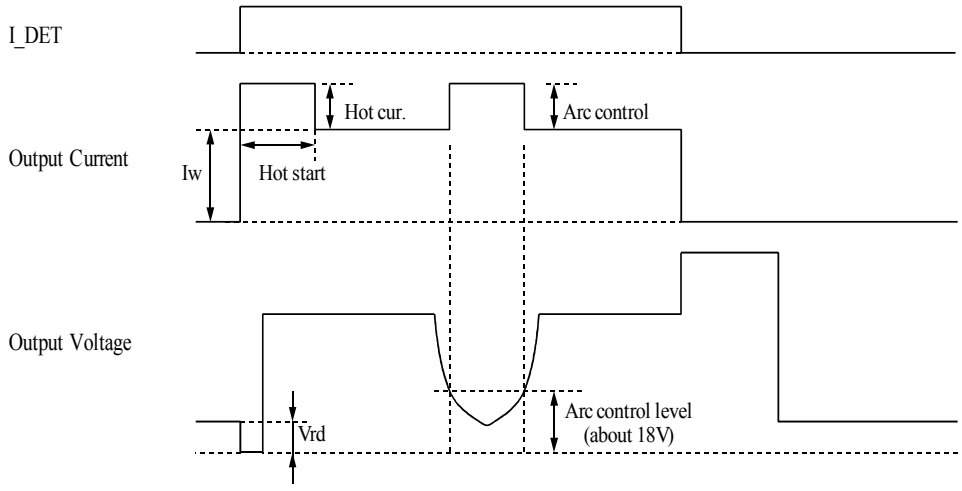


Figure 115 STICK mode timing with the VRD ENABLED

12.02 LIFT TIG Mode

12.02.01 LIFT TIG STD Mode

Figure 117 shows the LIFT TIG STD timing waveforms.

[STD MODE]

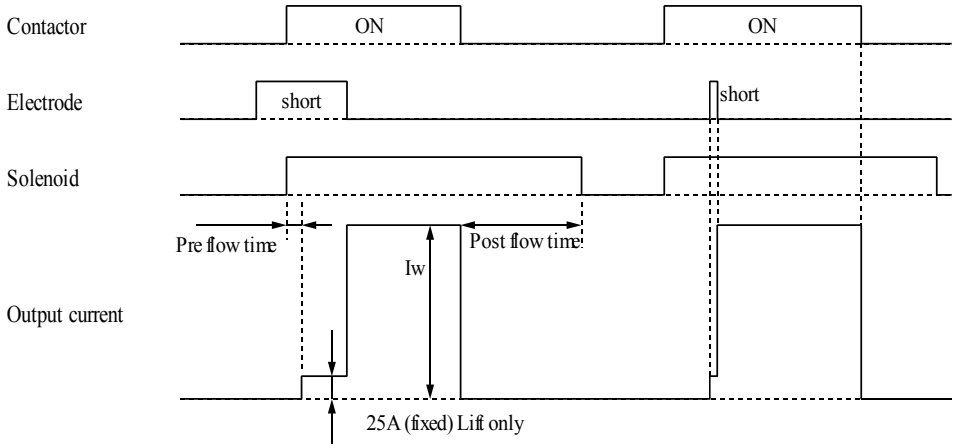
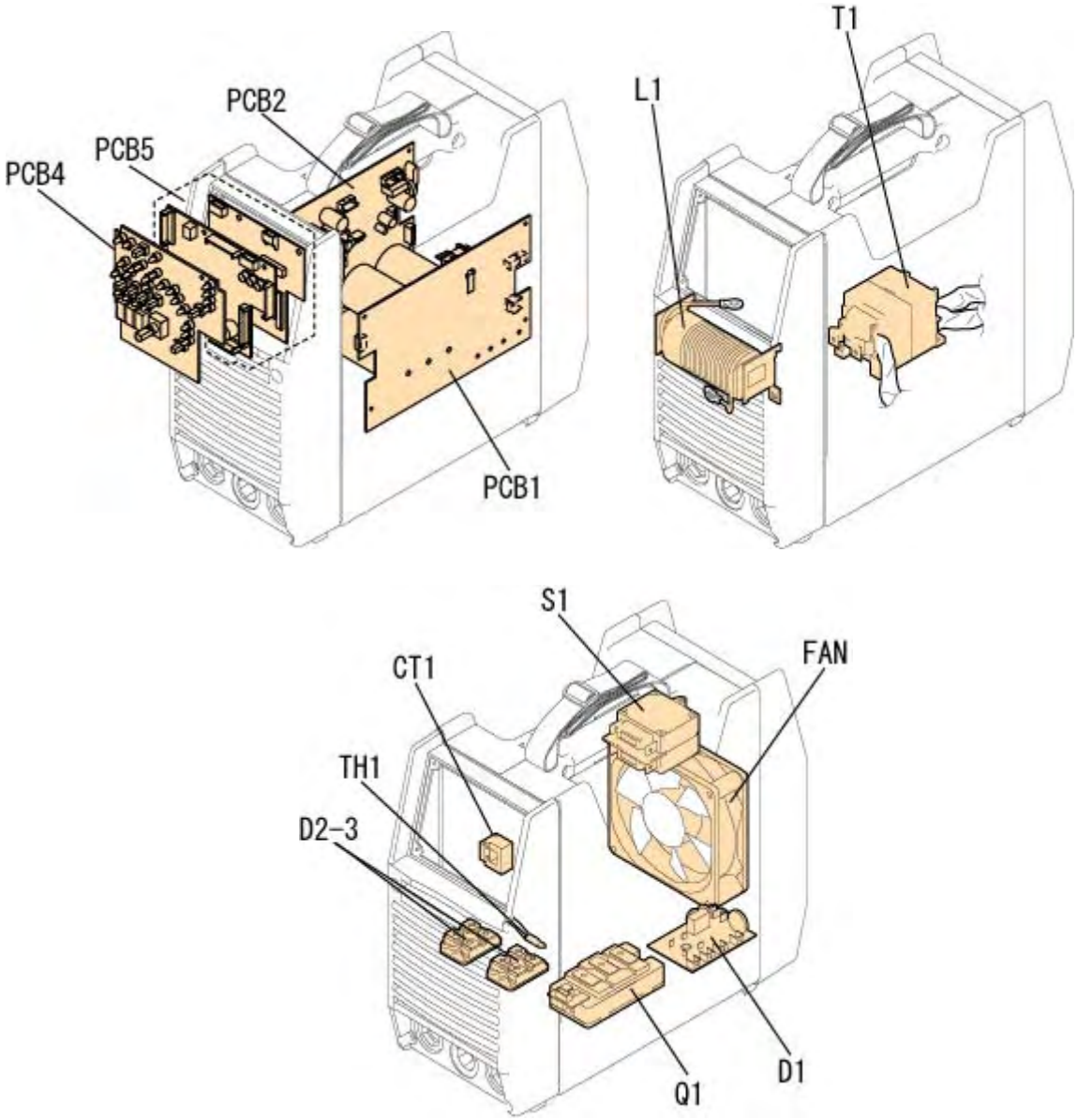


Figure 117 LIFT TIG STD mode timing

13.0 PARTS LIST



13.0 PARTS LIST

DWG. No.	Description	Type & Rating	QTY.	Code No.	Order No.
C1	Capacitor	SS351206PPQ1 DC 350V 20uF	1	42601003900	10-6685
C2**	Capacitor	ECKATS103MF 0.01uF	1	42442007100	10-2219
C3**	Capacitor	ECKATS103MF 0.01uF	1	42442007100	10-2219
C4**	Capacitor	ECW-H10H683JR DC1KV 0.068uF	1	42421138500	10-5013
C5-6**	Capacitor	ECW-H12H472JR 1200V .0047uF	2	42421141100	10-2216
CON1	Remote Socket	206433-1 8P (with Wiring Assembly)	1	U0A706200	10-6838
CT1	Current Sensor	HC-TN200V4B15M 200A 4V	1	11251003000	10-5003
D1	Diode	GBPC3508 800V 35A	1	44913000100	10-6686
D2-3	Diode	DBA200UA40	2	4582A0040	10-6687
FAN1	Fan	D12T24PS101 DC 24V w/harness protection	1	U0A738100	10-6840
L1	Inductor	F2A753900 200A STICK FCH	1	F2A753900	10-6688
L104	Inductor	1615MRE RING CORE	1	63200006500	10-6538
PCB1	Printed Circuit Board	WK-4980 U01 MAIN2 with Thunder Label	1	U0A706300	10-6689
PCB2	Printed Circuit Board	WK-4977 U01 MAIN1 with Thunder Label	1	U0A706400	10-6690
PCB4	Printed Circuit Board	WK-4985 U07 STICK PANEL	1	P0A498507	10-6691
PCB5	Printed Circuit Board	WK-4986 U01 CNTL1	1	P0A498601	10-6692
PCB6	Printed Circuit Board	WK-4987 U01 CNTL2	1	P0A498701	10-6693
PCB7	Printed Circuit Board	WK-5015 U01 DIODE PCB	1	P0A501501	10-6694
PCB8	Printed Circuit Board	WK-5071 U01 CONNECT PCB	1	P0A507101	10-6695
PCB9*	Printed Circuit Board	WK-5336 DIODE SNUBBER	1	P0A533600	10-6920
PCB10*	Printed Circuit Board	WK-5358 OUTPUT FILTER	1	P0A535800	10-6921

* Added, starting with serial number xxxxxxA103066

** Deleted, staring with serial number xxxxxxA103066

13.0 PARTS LIST Continued

DWG. No.	Description	Type & Rating	QTY.	Code No.	Order No.
Q1	Transistor	CM100DUS12F-2 600V 100A (with WK-3367 U04)	1	U0A706500	10-6696
R1	Resistor	ERG-3ANJ 472 3W 4.7kΩ	1	40305147200	10-5010
R3A**	Resistor	ERG3SJ330 3 W 33Ω	1	40305010100	10-6697
R3B**	Resistor	ERG3SJ330 3 W 33Ω	1	40305010100	10-6697
R4A**	Resistor	ERG3SJ330 3 W 33Ω	1	40305010100	10-6697
R4B**	Resistor	ERG3SJ330 3 W 33Ω	1	40305010100	10-6697
R5	Resistor	ERG-3ANJ 103 3 W 10kΩ	1	40305110300	10-5009
S1	Switch	DCP-52SR50C-480V 2P-480V	1	25850003500	10-6644
T1	Transformer	F2A704300	1	F2A704300	10-6698
TH1	Thermistor	ERTA53D203 20K"/25°C B=39 w/harness protection	1	U0A733200	10-6841
	Front Panel	E0D004500	1	U0A749600	10-6880
	Rear Panel	E0D004600	1	U0A749700	10-6881
	Side Panel	E0D006000	2	E0D006000	10-6701
	Front Control Cover	J4B515400	1	J4B515400	10-6702
	Rear Control Cover	JDA111800 (with Label)	1	U0A706800	10-6703
	Protection Cover	E1B500700	1	E1B500700	10-6704
	Encoder Cover	EBA514400	1	EBA514400	10-6654
	PCB Cover	E1B550900 (with Caution Label)	1	U0A706700	10-6705
	Strap	E5A937000	1	E5A937000	10-5069
	Name Label	N4A007300	2	N4A007300	10-6706
	“VRD INSIDE” Label	N4A155900	1	N4A155900	Ref. Only
	VRD Caution Label	N4A598700	1	N4A598700	23X4915
	Primary Power Hook-Up Label	N4A598200	1	N4A598200	23X4914
	Side Label	N4A009100	2	N4A009100	10-6707

** Deleted, staring with serial number xxxxxxA103066

13.0 PARTS LIST Continued

DWG. No.	Description	Type & Rating	QTY.	Code No.	Order No.
	Warning Label 1	N4A072400	1	N4A072400	10-6708
	Warning Label 2	N4A072500	1	N4A072500	10-6709
	Output Terminal Label	N4A057700	1	N4A057700	10-6710
	Output Terminal (female)	TRAK-BE10-25	2	26999025700	10-6711
	Input Cable	132” 12/3SOW BLK W/5-15P	1	52031130100	N/A
	Input Cable	132” 10/3SOW BLK [1]	1	U0A815200	N/A
	Input Cable Clamp	SCLB18A	1	53613021800	10-6712
	Input Cable Clamp	N/A [1]	1	N/A	N/A
	Heatsink	E1B575400	1	E1B575400	10-6713
	Knob	2615603	1	50990001500	10-6714
	Knob Cap	3015104	1	50990003500	10-6715
	Control Cover Sheet	N0B883100	1	N0B883100	10-6716
	Flat Cable (Long)	EAA547301	1	EAA547301	10-6668
	Flat Cable (Short)	EBA420200	1	EBA420200	10-6717
	Q-Post (M5)	EBA436000	1	EBA436000	10-6674
	D-T Bus Bar	EBA447900	2	EBA447900	10-6718
	Q Bus Bar1	EBA448200	2	EBA448200	10-6719
	Q Bus Bar2 (C2E1)	EBA551900	1	EBA551900	10-6720
	Diode Bus Bar	EBA508300	1	EBA508300	10-6721
	Clip	#74 NATURAL	4	60602422000	10-5259
	Front Chassis	J3C009200	1	J3C009200	10-6722
	Rear Chassis	J3C010800	1	J3C010800	10-6723
	Capacitor Chassis	JDA117700	1	JDA117700	10-6724
	HF. Unit Chassis	J4B549700	1	J4B549700	10-6725
	Output Terminal (male)	TRAK-SK10-25	2	26999025600	10-1068
	Operating Manual		1		430429-504
	Service Manual				430429-513

[1] CSA unit only.

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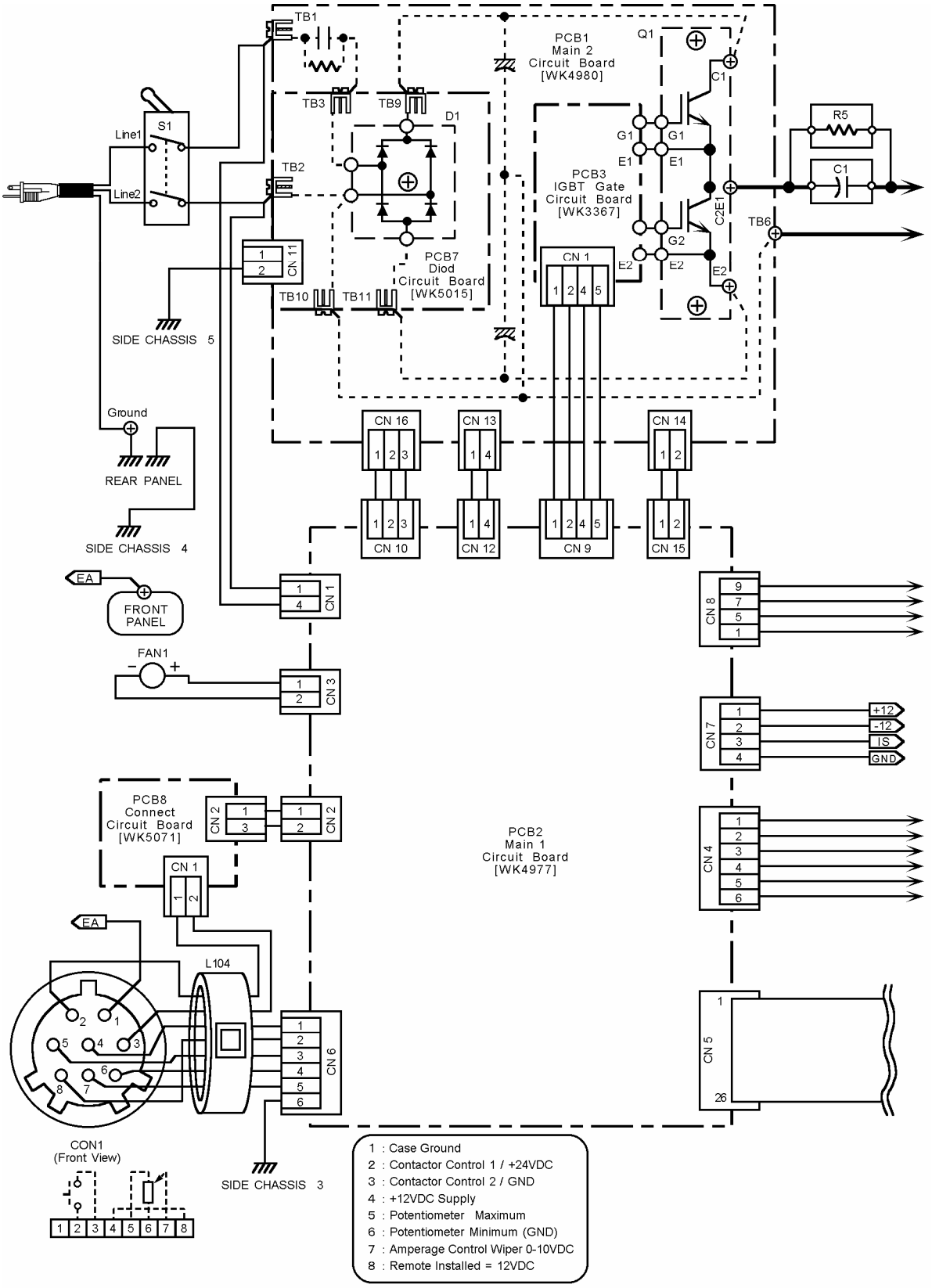
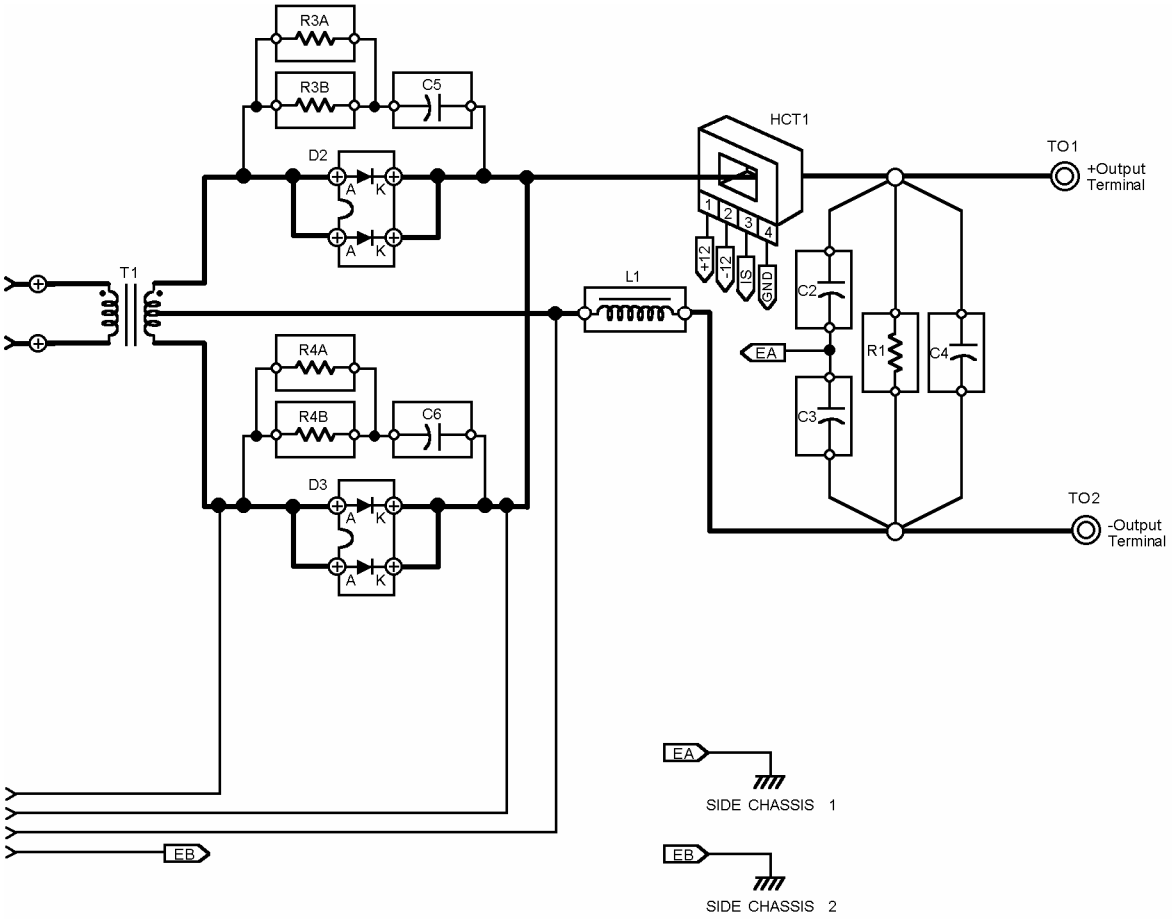
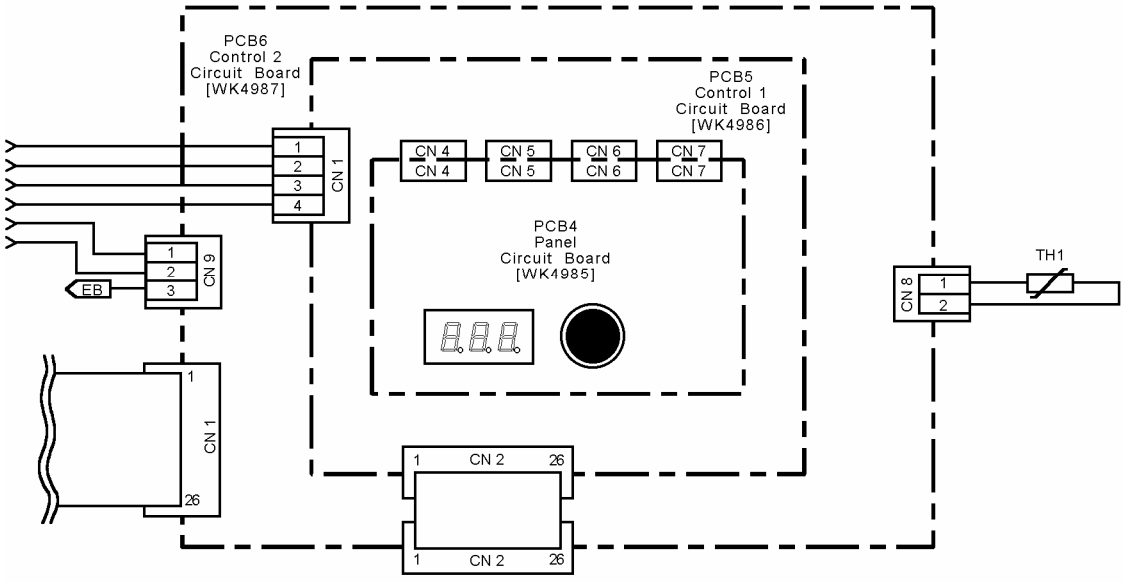
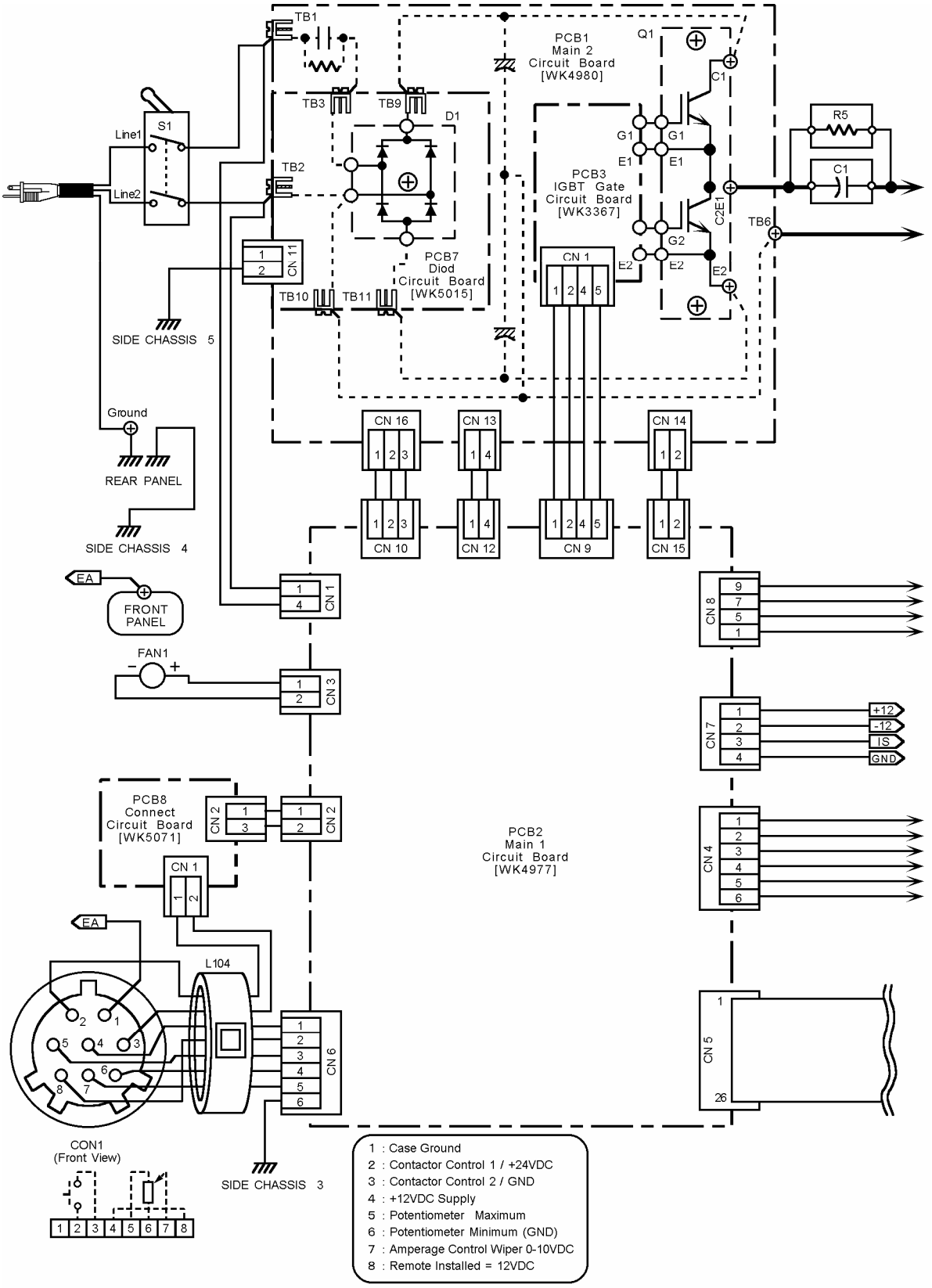
APPENDIX A - INTERCONNECT DIAGRAM
(serial numbers xxxxxxA3066 and earlier)

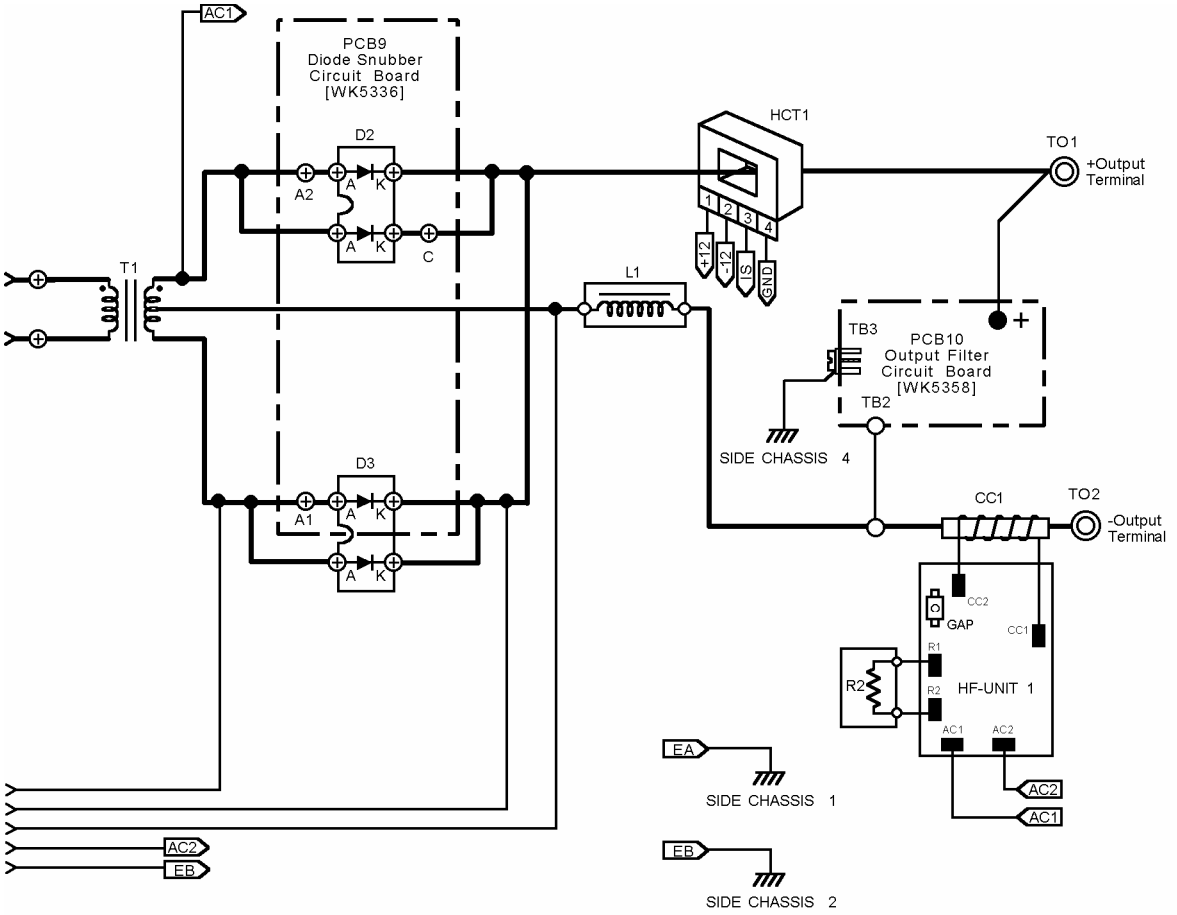


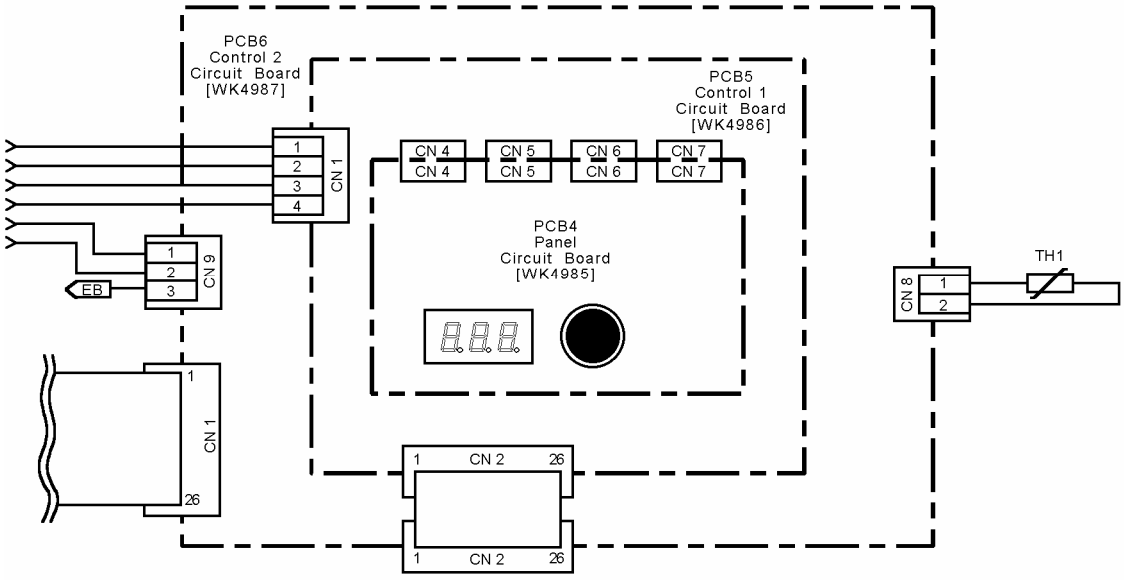

R3A
R3B
C5
D2
A
K
HCT1
TO1
+Output
Terminal
1
2
3
4
+12
-12
S
GND
T1
L1
C2
R1
C4
EA
C3
R4A
R4B
C6
D3
TO2
-Output
Terminal
EB
EA
SIDE CHASSIS 1
EB
SIDE CHASSIS 2


PCB6
Control 2
Circuit Board
[WK4987]
PCB5
Control 1
Circuit Board
[WK4986]
CN 1
CN 4
CN 5
CN 6
CN 7
PCB4
Panel
Circuit Board
[WK4985]
CN 9
EB
TH1
CN 8
CN 1
CN 2
26

APPENDIX B - INTERCONNECT DIAGRAM
(serial numbers xxxxxxA3066 and later)



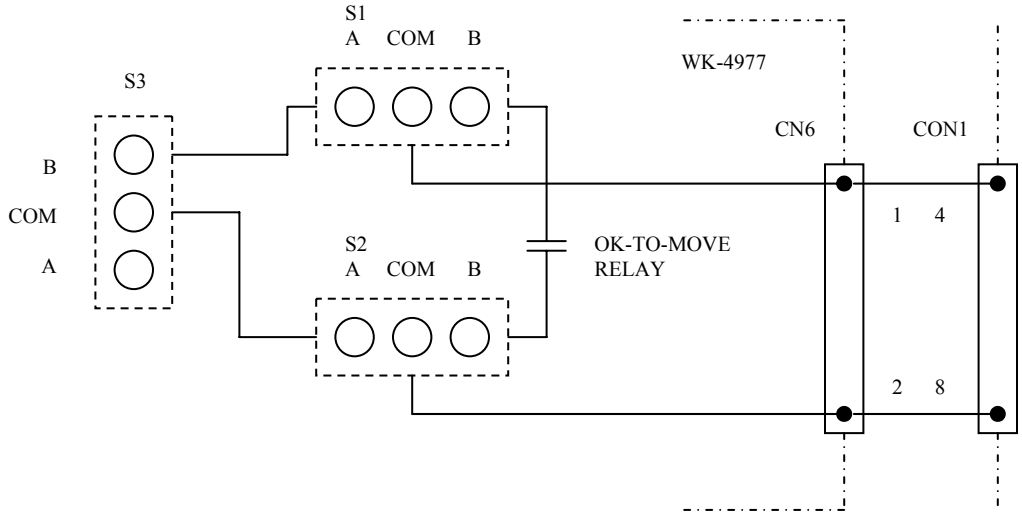

AC1
PCB9
Diode Snubber
Circuit Board
[WK5336]
D2
A2
A
K
C
HCT1
TO1
+Output
Terminal
1
2
3
4
+12
-12
IS
GND
T1
L1
TB3
PCB10
Output Filter
Circuit Board
[WK5358]
TB2
SIDE CHASSIS 4
D3
A1
CC1
TO2
-Output
Terminal
CC2
GAP
R1
R2
HF-UNIT 1
AC1
AC2
EA
SIDE CHASSIS 1
EB
SIDE CHASSIS 2


PCB6
Control 2
Circuit Board
[WK4987]
PCB5
Control 1
Circuit Board
[WK4986]
CN 1
CN 4
CN 5
CN 6
CN 7
PCB4
Panel
Circuit Board
[WK4985]
CN 9
EB
CN 8
TH1
CN 2
26

APPENDIX C - AUTOMATION

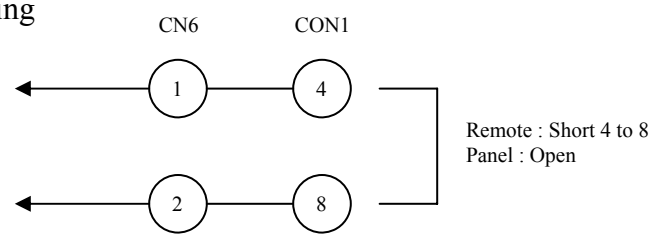
SLIDE SWITCH SETTING FOR "OK–TO–MOVE". Models 160S/TS

Three slide switches (S1, S2 and S3) are provided on PC Board WK-4977 for automation purposes. This PCB is the units right side main PCB. This PCB can be accessed by removing the side covers by loosening 4 screws on each the front and rear panel, then removing the 4 side panel screws as well as the 2 handle screws. Carefully pull the front and rear panels outward to release and remove the side cover. Lift up the protective PCB cover sheet from the bottom and the slide switches will be accessible through a slot in the PCB Board. See figure on next page for details.
All units are shipped from the factory with the slide switches set in position "A". This is for normal semi-automatic operation utilizing a remote device, such as a foot control. The 8-pin remote operates as described earlier in this manual.
Placing all slide switches in position "B" would be primarily used for automation with an arc establish relay, remote amperage and contactor. An arc-establish signal is located from pins 4 and 8 when in this mode.
Placing slide switches S1 and S2 in "B" position and slide switch S3 in "A" position would have the configuration of an arc-establish signal and remote contactor, but the unit's front panel would control the amperage**.**



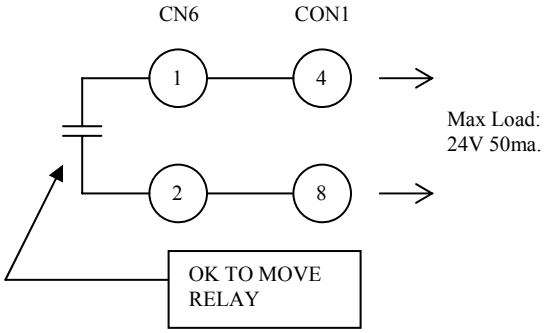
• Set All "A" position : factory shipping

	POSITION
S1	A
S2	A
S3	A



• Use "OK TO MOVE signal"

	POSITION	
S1	B	B
S2	B	B
S3	B	A
A/V	REMOTE	PANEL



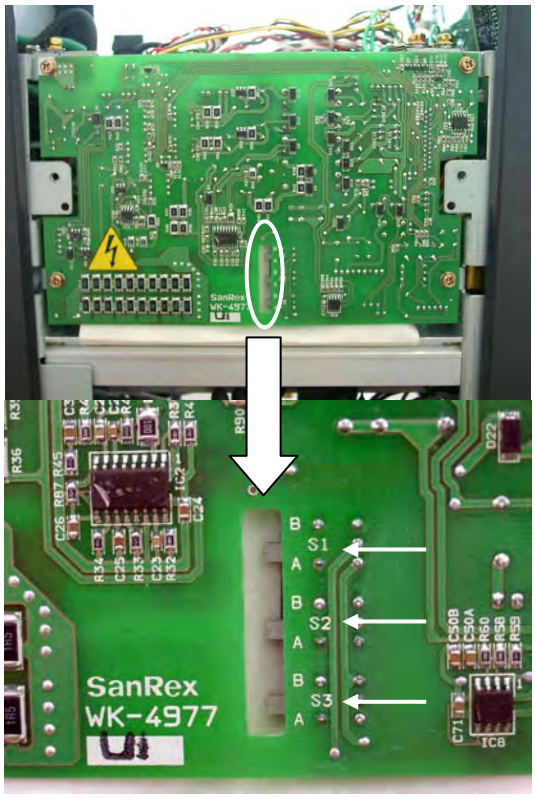


Figure 18 – Slide Switch Location

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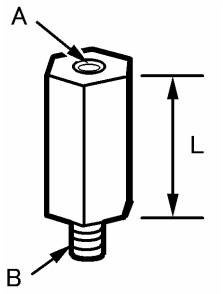
APPENDIX D – HARDWARE

Description	L	A	B	Code No.	Order No.
Post1 (M4-M5)	9mm	M4	M5	EAA424900	10-6669
Post2 (M5-M5)	11.4mm	M5	M5	EBA425000	10-6801
Post3 (M5-M5)	23mm	M5	M5	EBA425100	10-6802
Post4 (M4-M4)	20mm	M4	M4	EBA431100	10-6670
Post5 (M4-M4)	22mm	M4	M4	EBA431200	10-6671
Post6 (M5-M5)	21mm	M5	M5	EBA431300	10-6672
Post7 (M5-M5)	20mm	M5	M5	EBA435900	10-6673
Post8 (M5-M5)	10mm	M5	M5	EBA436000	10-6674
Post9 (M5-M5)	19mm	M5	M5	EBA491700	10-6750
Post11 (M5-M5)	9mm	M5	M5	EBA643600	10-6751
Post421 (M4-M4)	21mm	M4	M4	53602020600	10-6803



APPENDIX E – DIODE TESTING BASICS

Testing of diode modules requires a digital Volt/Ohmmeter that has a diode test scale.

Locate the diode module to be tested.
2. Remove cables from mounting studs on diodes to isolate them within the module.
3. Set the digital volt/ohm meter to the diode test scale.
4. Using figure 1 and 2, check each diode in the module. Each diode must be checked in both the forward bias (positive to negative) and reverse bias (negative to positive) direction.
5. To check the diode in the forward bias direction, connect the volt/ ohm meter positive lead to the anode (positive, +) of the diode and the negative lead to the cathode (negative, -) of the diode (refer to figure 1). A properly functioning diode will conduct in the forward bias direction, and will indicate between 0.3 and 0.9 volts.
6. To check the diode in the reverse bias direction, reverse the meter leads (refer to figure 1). A properly functioning diode will block current flow in the reverse bias direction, and depending on the meter function, will indicate an open or "OL".
7. If any diode in the module tests as faulty, replace the diode module.
8. Reconnect all cables to the proper terminals.

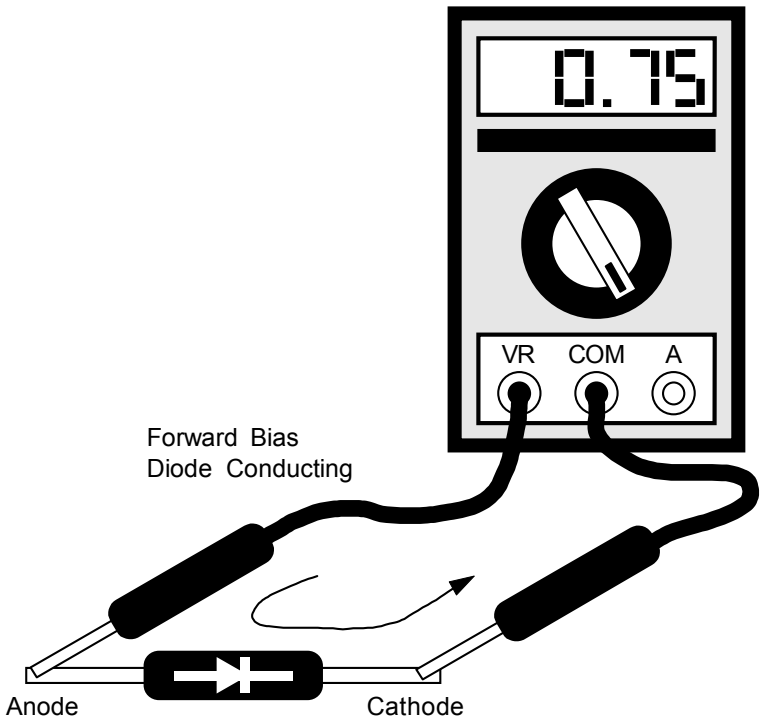


Figure 1. Forward bias diode test

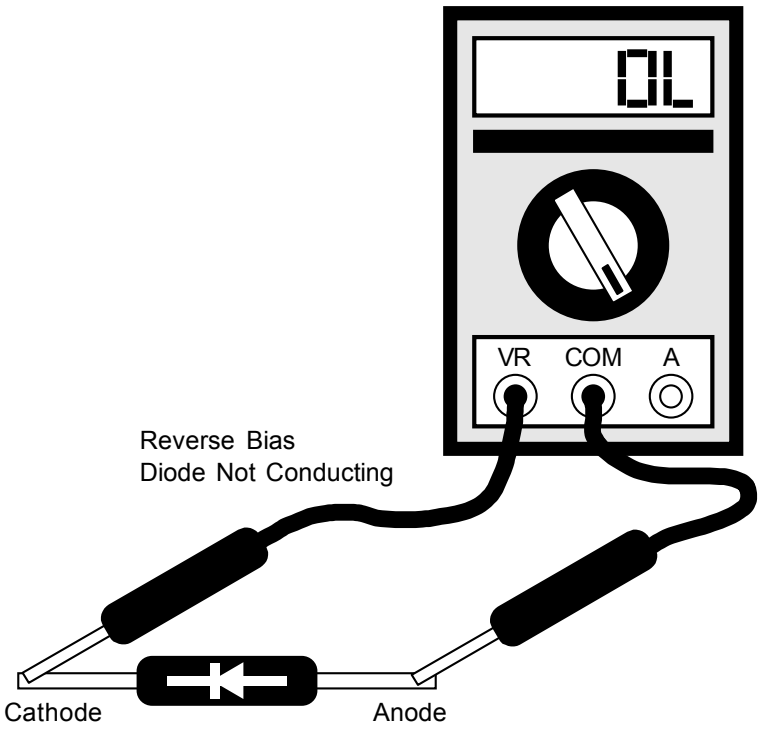


Figure 2. Reverse bias diode test